

SunPower Performance Panels

SUNPOWER

FROM MAXEON
SOLAR TECHNOLOGIES

Outline

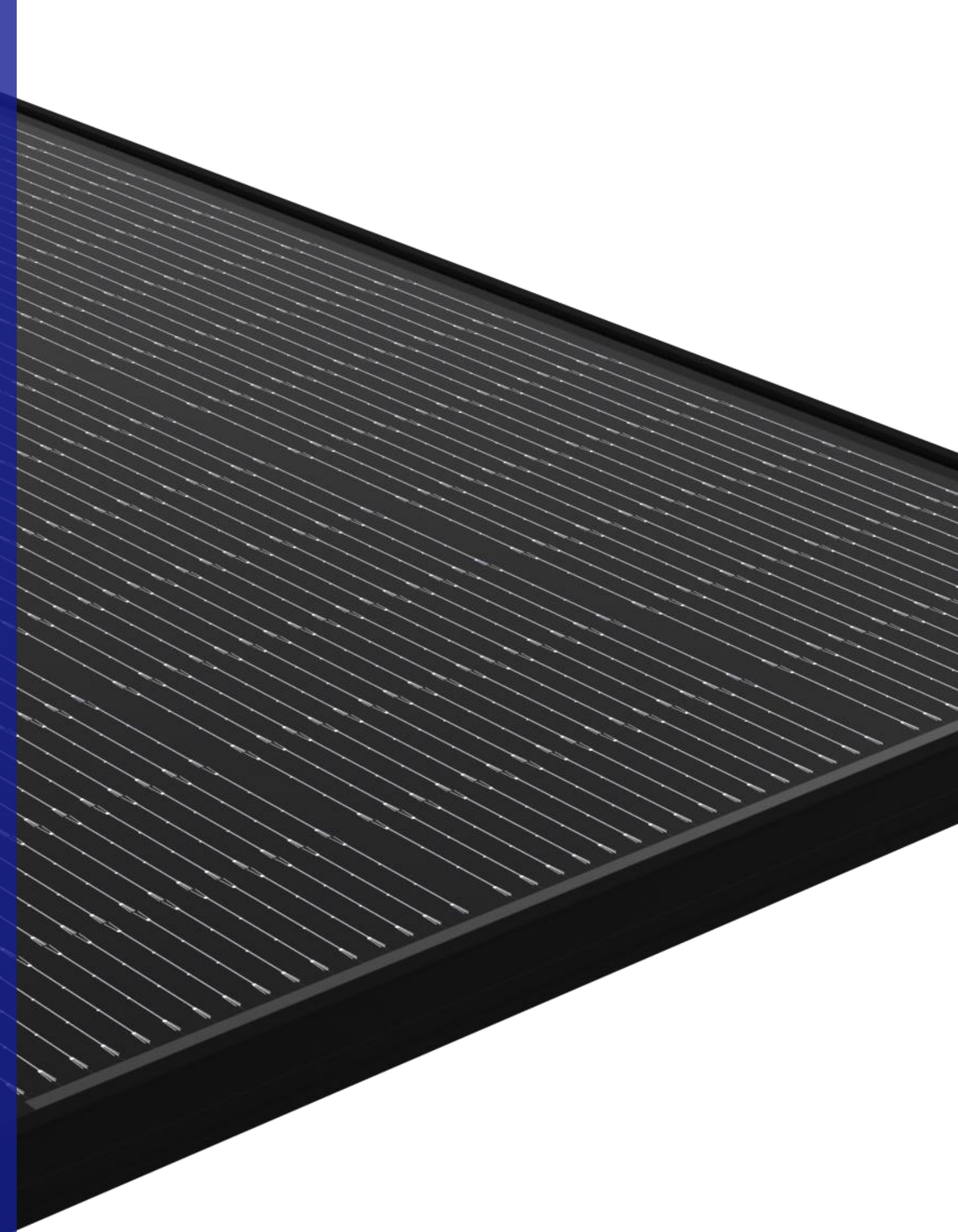
1. Introduction

- Engineering a Better Panel

2. Overview of Performance 7 Panel

- Shingled, One-Third Cut Cell Design
- Shade Management
- Flexible Joint Cell Interconnect
- High Quality Materials and Construction
- Bifacial Generation
- Comprehensive Warranty

3. Performance 7 Panel Portfolio



Engineering a better panel

Focusing on reliability to protect against known failure points in standard solar panels.

Independent reliability validation

Performance panels are a consistent Top Performer in PVEL Reliability Scorecard¹



Performance panels have been regularly recognised as a Top Performer in the PVEL PV Module Reliability Scorecard.

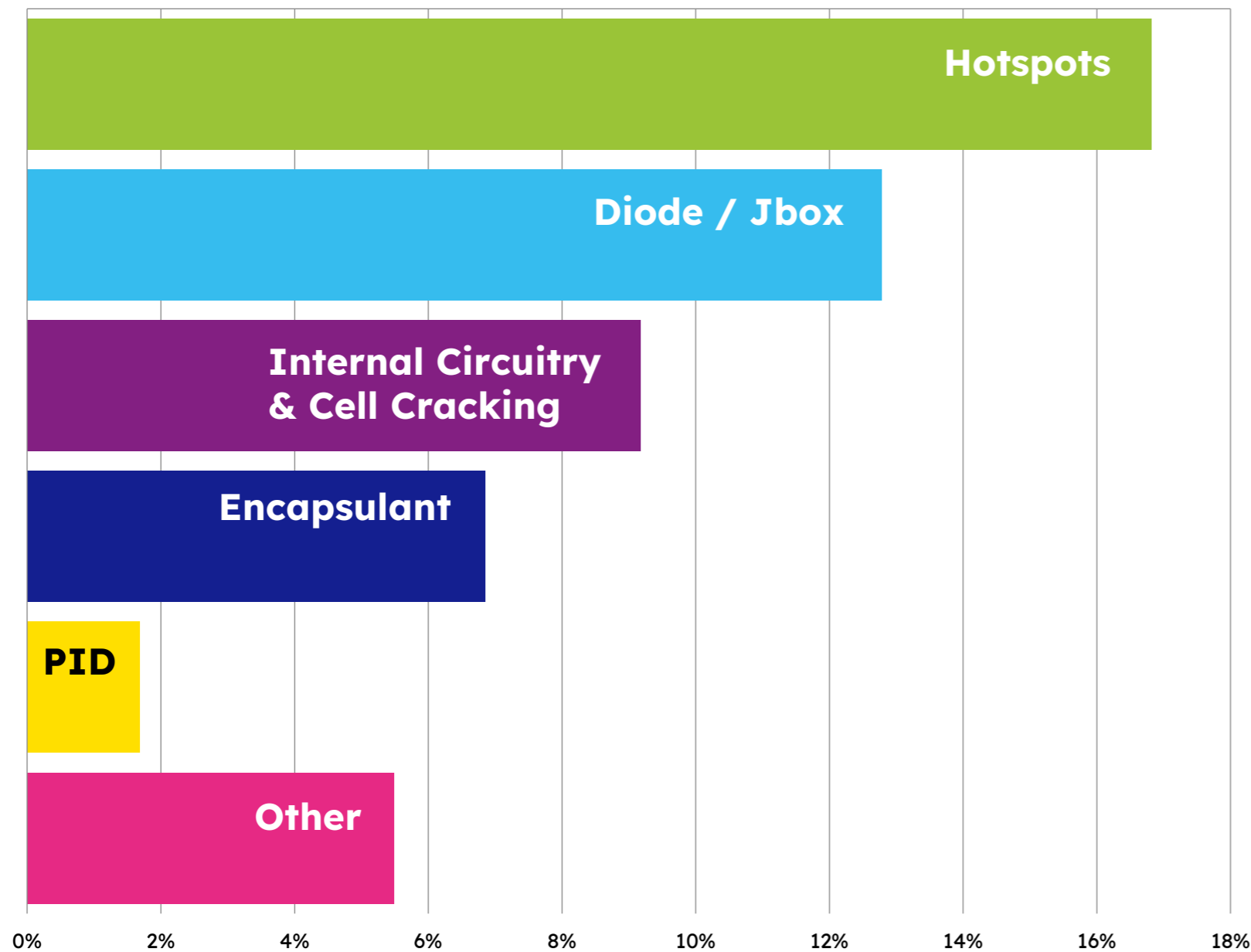
Based on data from its Product Qualification Program (PQP), the PVEL Scorecard highlights the exemplary reliability performance of solar panel manufacturers worldwide.



¹ 2023 PVEL (PV Evolution Labs) PV Module Reliability Scorecard: <https://modulescorecard.pvel.com/>

Common causes of solar panel degradation

Dupont estimates that up to 30% of panels may see reliability issues within their first 10 years of operation¹



The research of Jordan et. al. has gone a bit further to quantify the presence of key degradation modes in the field—finding hotspots and related electrical infrastructure problems to be the predominant issues affecting solar panel reliability.

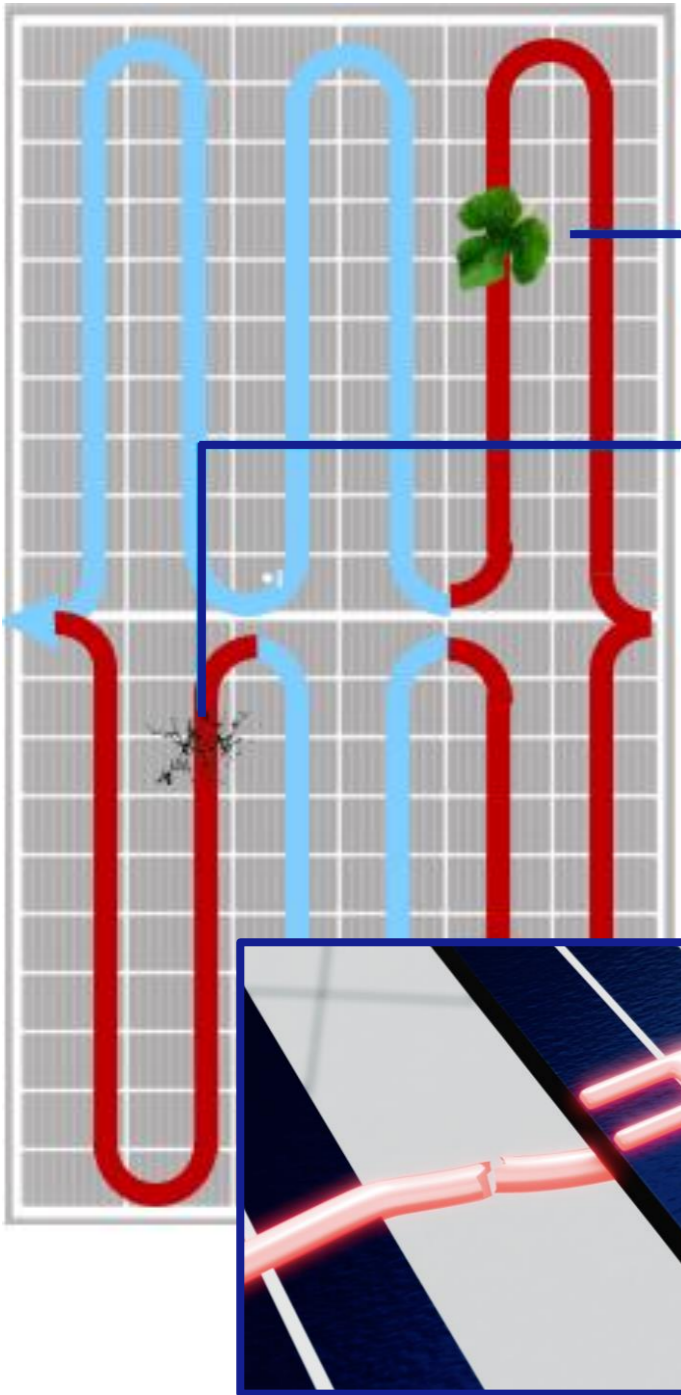
The impact can be significant, including energy yield losses, inverter uptime issues, and even outright panel failure.

Maxeon panels are uniquely designed and engineered to target these key degradation modes that affect solar panel performance over their initial 10 years of operation.

1. DuPont global PV reliability study (2020). Inspection observations based on 3GW in field. DuPont Global-Field-Reliability-Report-2020.pdf 2. Chart source information: Jordan, D. C., Silverman, T. J., Wohlgemuth, J. H., Kurtz, S. R., and VanSant, K. T. (2017) Photovoltaic failure and degradation modes. Prog. Photovolt: Res. Appl., 25: 318– 326. doi: [10.1002/pip.2866](https://doi.org/10.1002/pip.2866). Study assessed field data from more than 150 project reports, representing more than 28,000 panels. Chart presented here focuses on degradation modes observed in the first 10 years of operation for projects installed post-2000.

Common causes of solar panel degradation

How standard panels degrade and fail



Power flow is blocked by shade or soiling

Cells crack from manufacturing quality, installation and transport, or snow and wind loads

Ribbon soldering corrodes or fails from manufacturing quality, temperature swings, humidity, or snow and wind loads

Cell goes into reverse bias

Diode activates to isolate section of panel with the affected cell

Over time, this diode wears out and affected cells are allowed to run in reverse bias



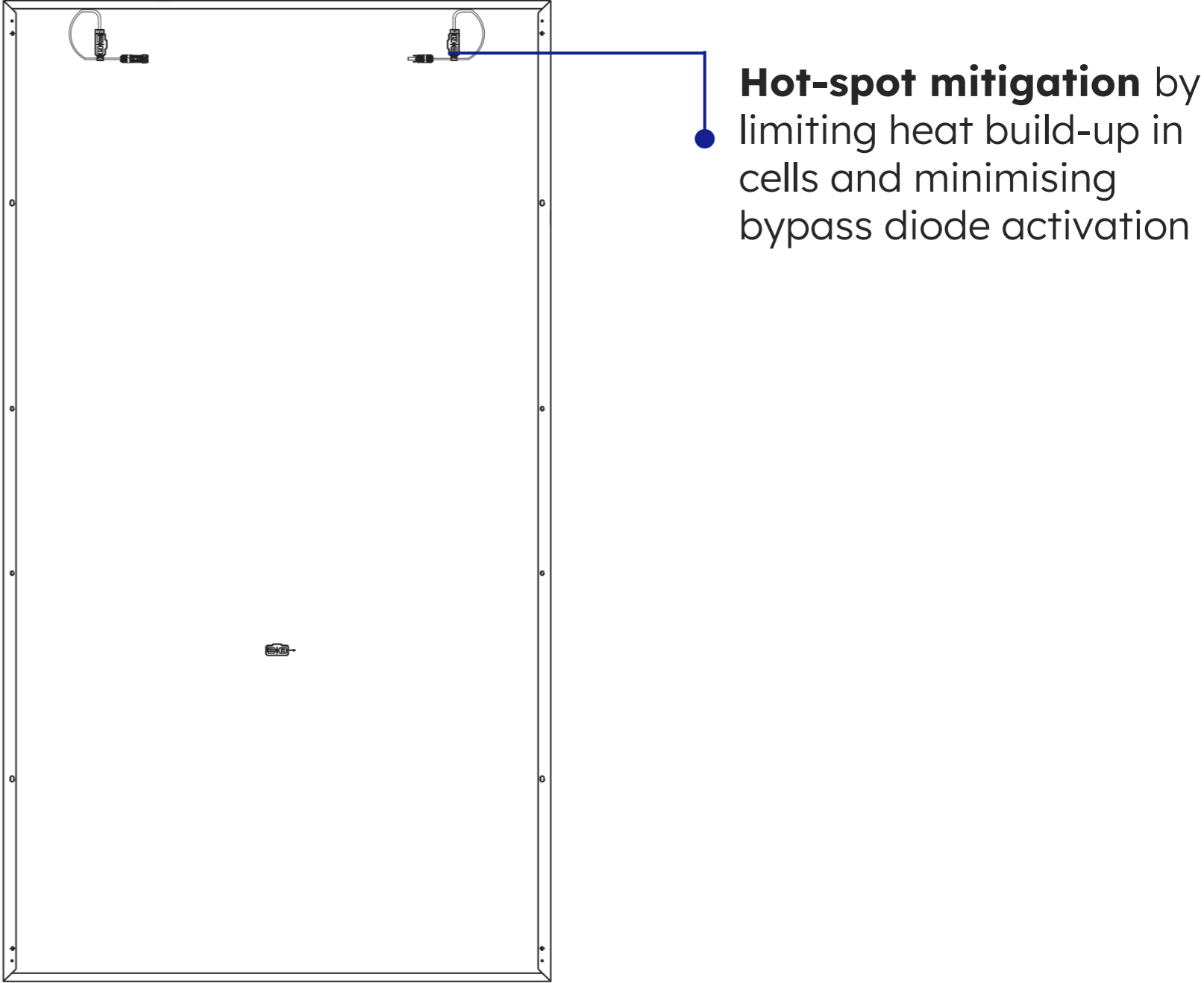
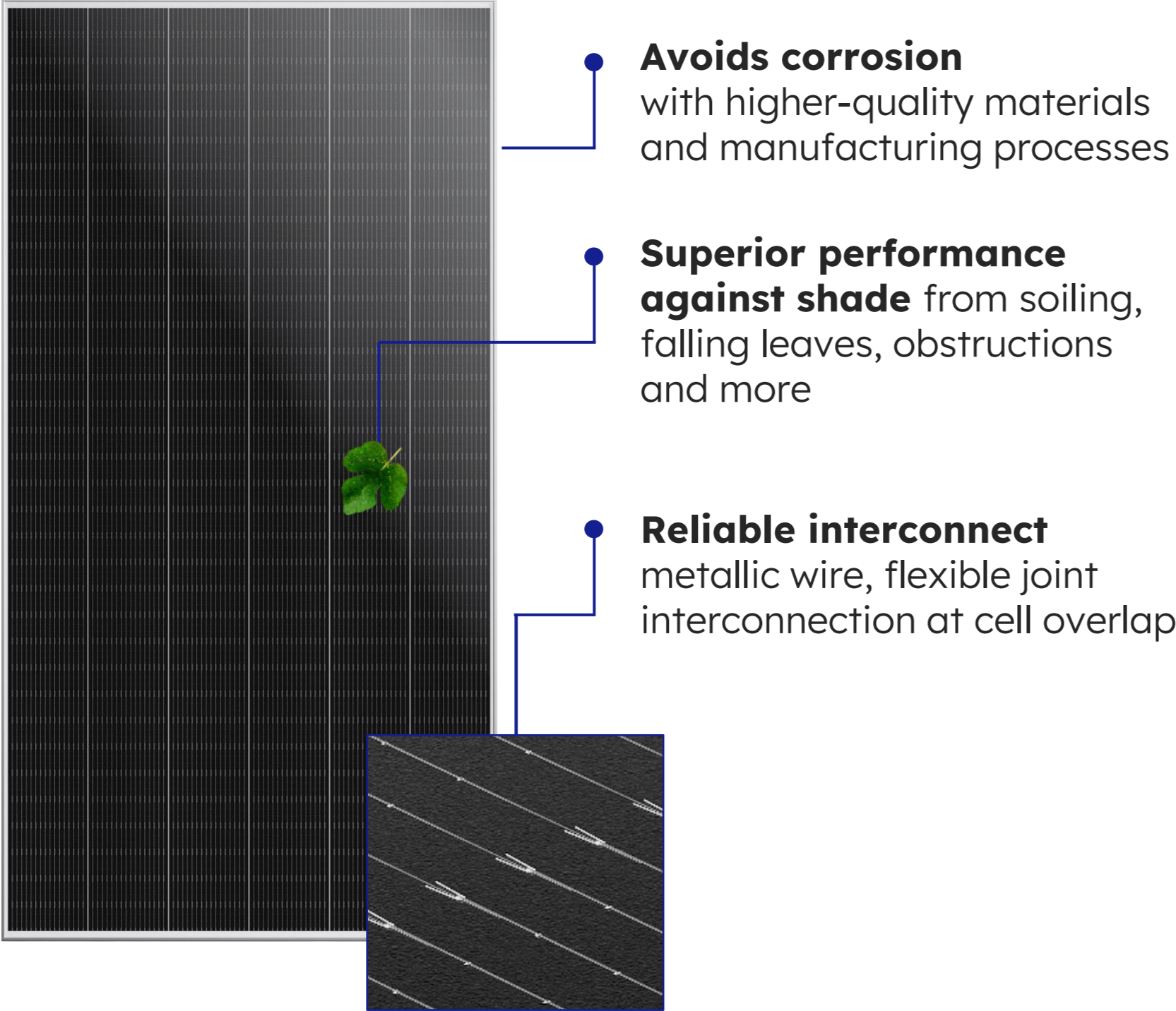
Hotspots

Burned backsheet and discoloration

Glass breakage

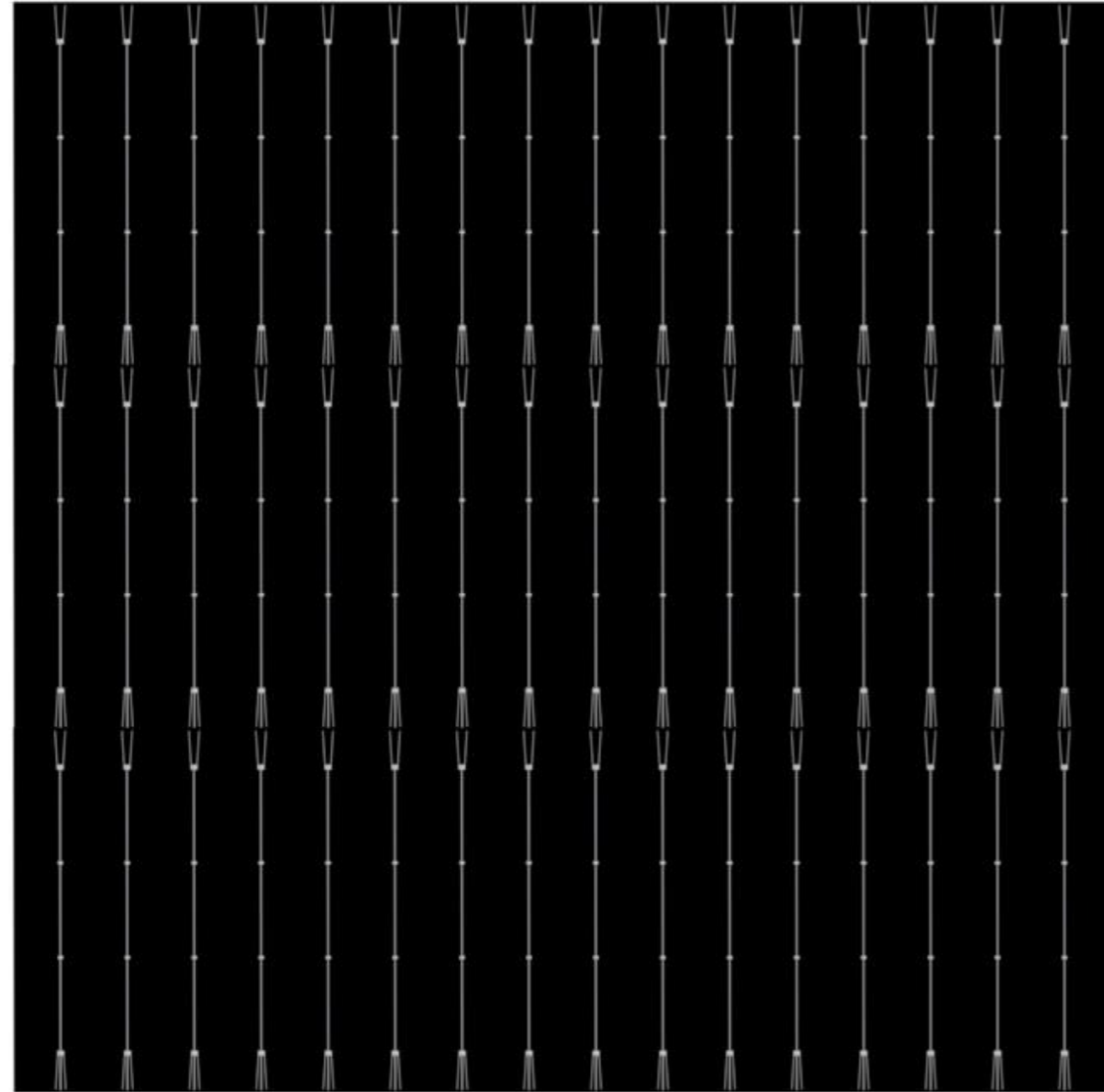
Engineering a more reliable panel

Performance panels are engineered to eliminate common degradation modes



Performance has evolved

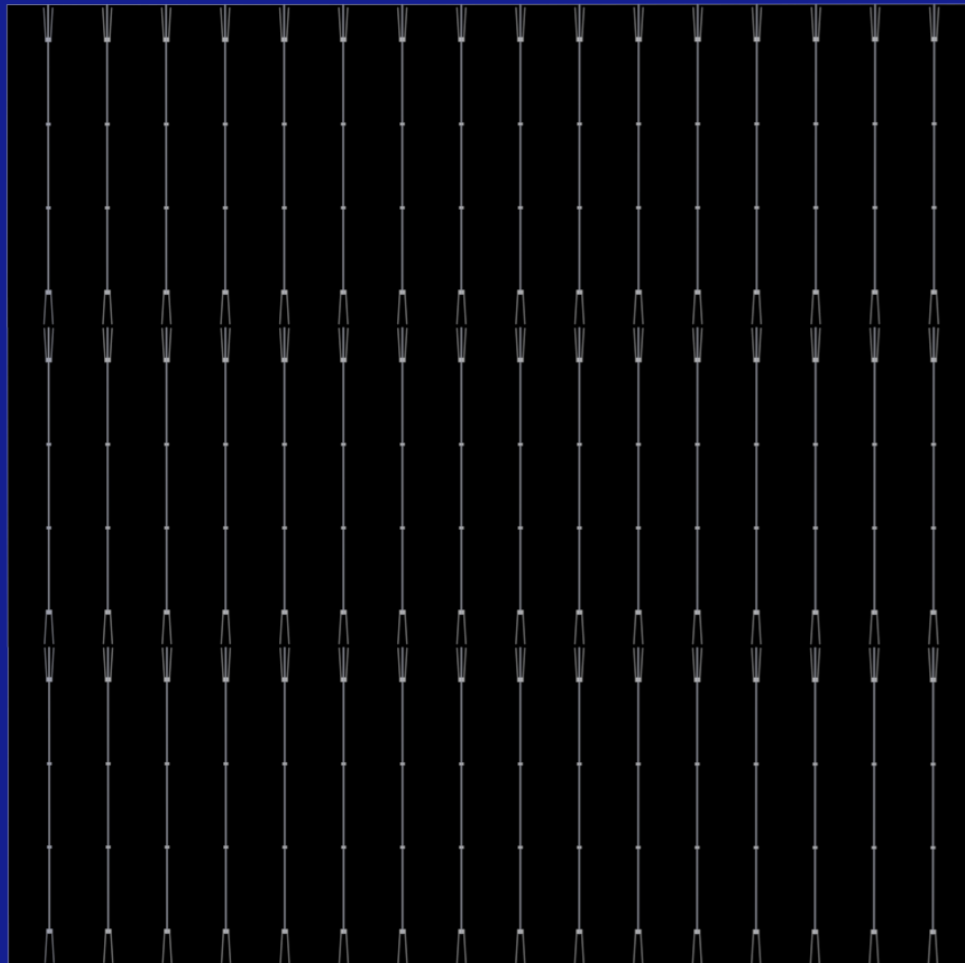
A focus on the product line's latest technology.



Performance 7 panels feature:
N-type TOPCon Solar Cells

CELL TECHNOLOGY

TOPCon Solar Cells: The next evolution of solar cells



While traditional PERC solar cells have dominated the market, a new contender has emerged:

TOPCon (Tunnel Oxide Passivated Contact).

This cutting-edge technology is the next evolution of the solar industry with its high efficiency and solar production specifications.

CELL TECHNOLOGY

TOPCon Solar Cells: What makes them stand out?

High Conversion Efficiency

Converting more sunlight into electricity with high efficiency. TOPCon cells generally outperform standard solar cells, meaning you can generate more power from the same amount of sunlight.

Strong and Reliable

The cell design makes them more resistant to degradation caused by heat and light. Resulting in better solar production in real-world conditions, especially on hot days and in low light settings.

Low degradation rates

Standard cells lose efficiency more rapidly over time, TOPCon cells boast impressively low degradation rates (0.40%)¹. This translates to higher energy output over a longer period.

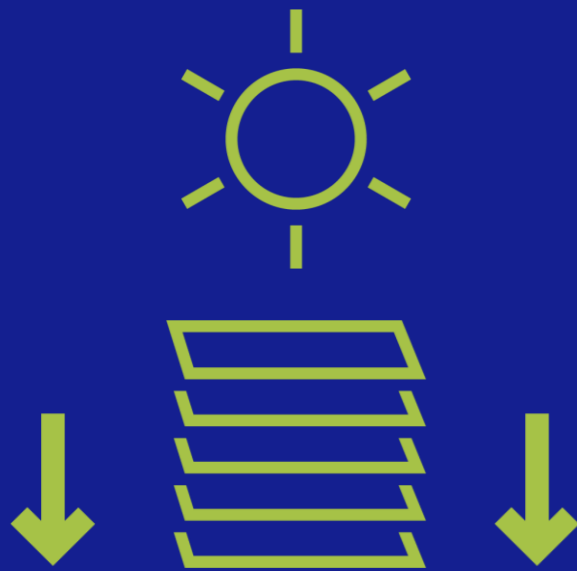
Temperature Coefficient

The low temperature coefficient (0.29%)² of TOPCon solar cells offers a distinct advantage: minimised efficiency loss in high temperatures resulting in better energy generation in increasingly hot climates.

CELL TECHNOLOGY

N-type TOPCon solar cells

Additional benefits of the new TOPCon cells include...




Lower Light-Induced Degradation



Potential-Induced Degradation Resistance



Increases to Bifaciality



Improved Low-Light Production

CELL TECHNOLOGY

TOPCon Solar Cells: When integrated with Performance modules

**Up to
22.7%**

Module efficiency¹

87.4%

Power at 30 years²

80.0%

Bifacial factor³

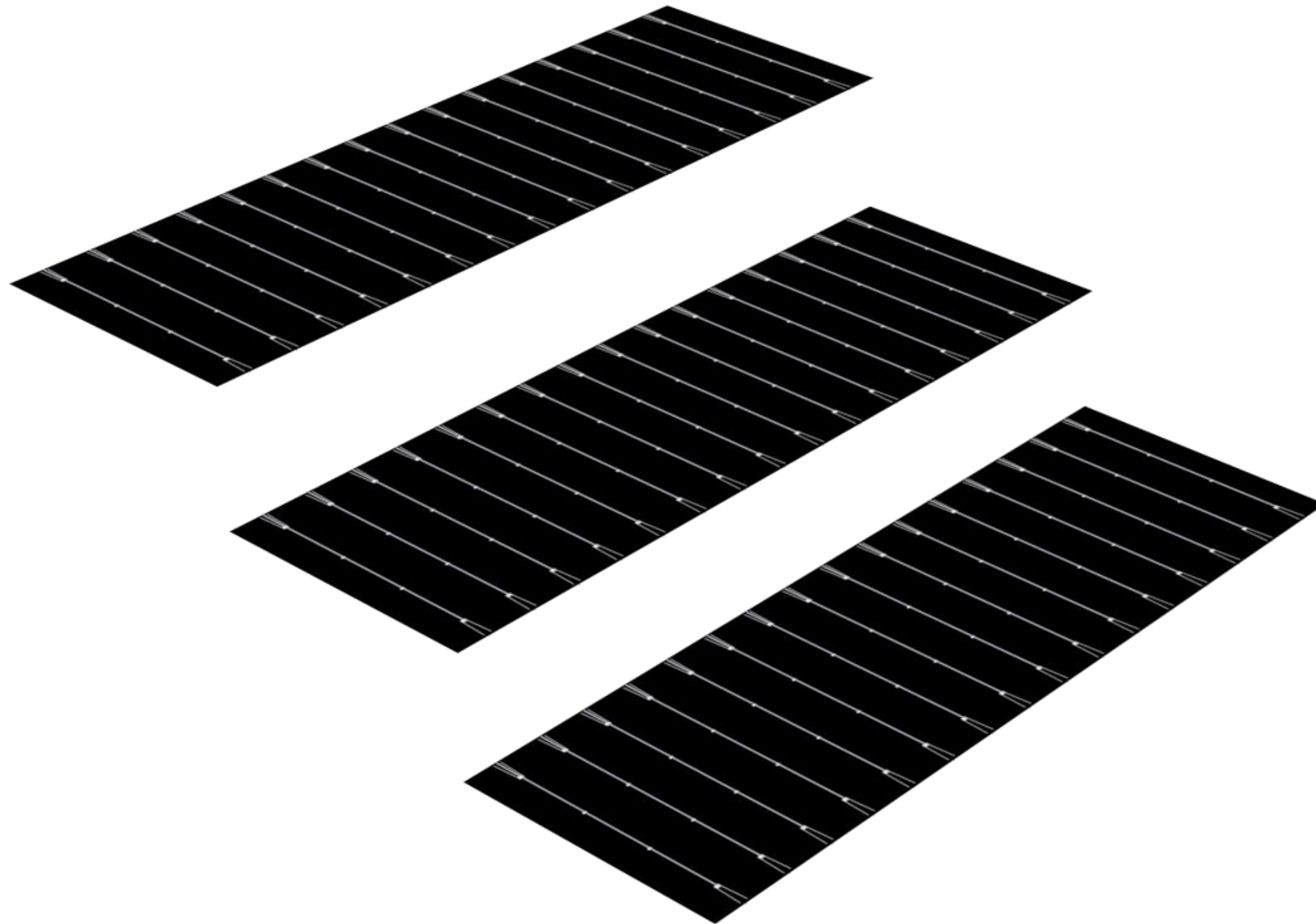
¹ Based on P7-COM-S Panel.

² Based on Performance panels warranted power at 30 years. Refer to warranty for details.

³ Applicable to Performance Commercial panel SKUs only. ± 10%.

CELL DESIGN

One-third cut cells



Bigger isn't always better

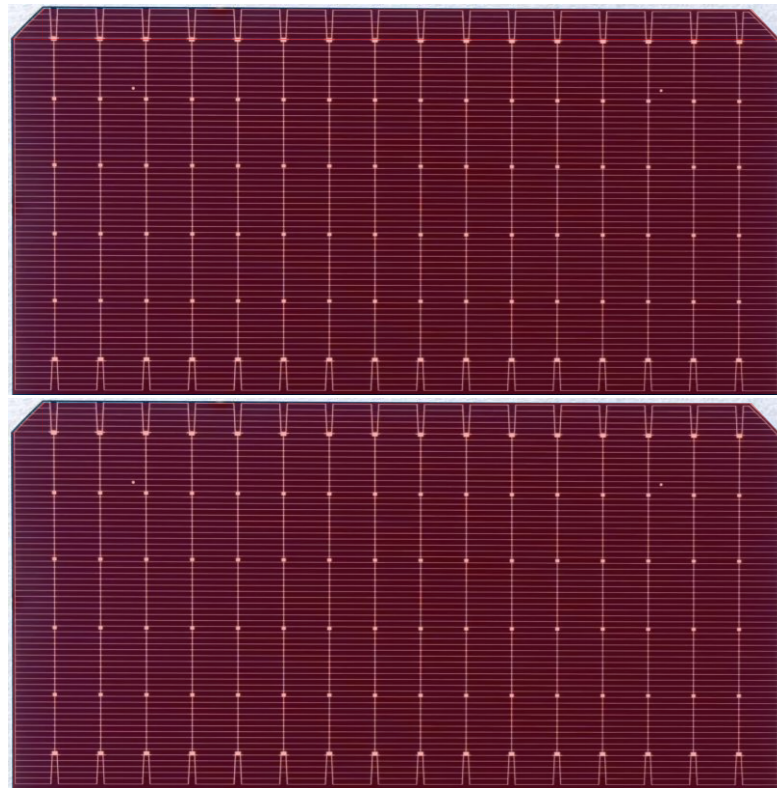
Smaller cells have shorter paths for the electricity to flow, so less gets lost on the way. This means **less wasted energy** and **more usable power**.

Smaller one-third cut cells **improve shade tolerance** over standard solar. Think of smaller cells as independent workers. If one gets shaded, the others keep working hard, so the whole panel doesn't suffer as much. Plus, there's **less chance of burning hotspots** from shade.

CELL DESIGN

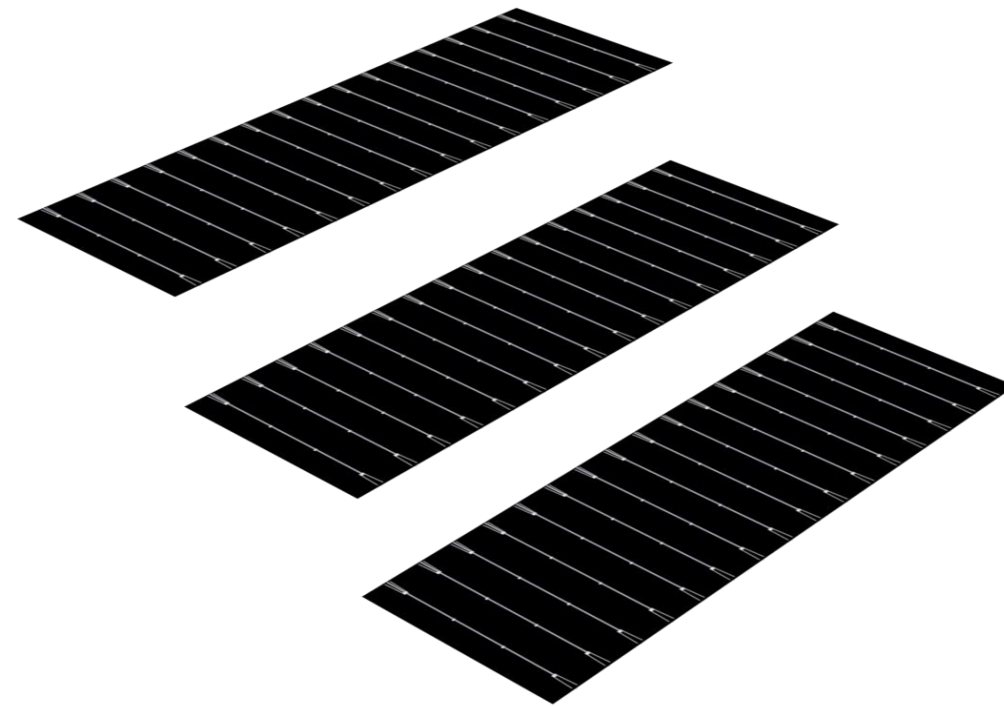
One-third cut cells

Standard Cells
Half Cut TOPCon



Reached temperatures of up to 192°C during hotspot testing.¹

Performance 7 Cells
One-third cut TOPCon



Operating temperatures were up to 40°C cooler during the same hotspot testing.¹

Temperature coefficient is only half of the story

In high-irradiance conditions, smaller solar cells exhibit **superior thermal performance** compared to their larger counterparts. This advantage stems from reduced internal current density, meaning **less heat generation** within the cell. Consequently, power degradation due to thermal effects is minimised, resulting in **enhanced efficiency** during peak sun hours.

Additionally, the lower operating temperatures promote **extended panel lifespans** and assist in **mitigating hotspot damage**.

¹Based on internal R&D hotspot and shade testing vs standard half cut TOPCon panels.



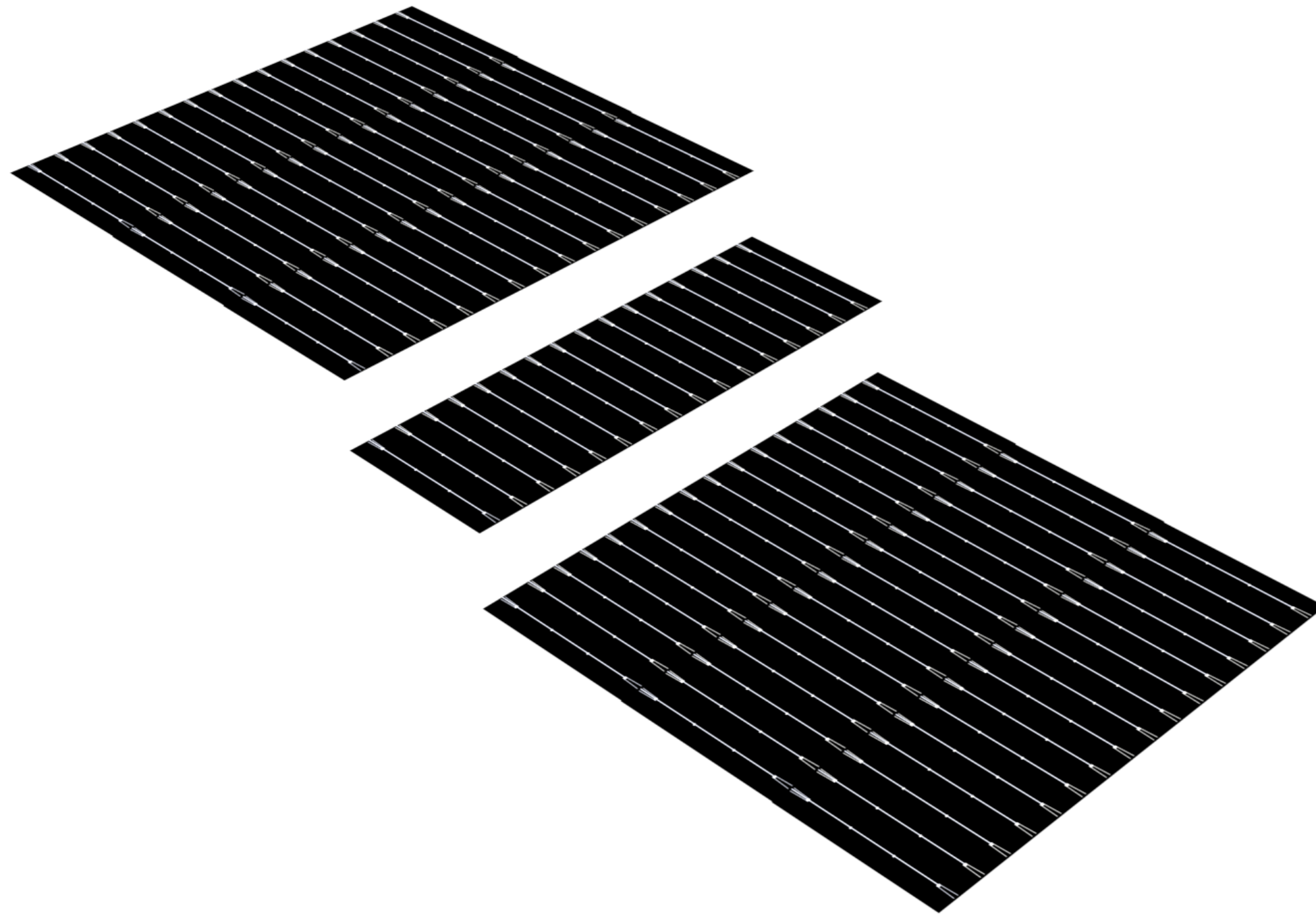
CELL DESIGN our one-third cut cells can handle the heat

Performance 7 operates 20-40°C cooler than standard panels in shade¹

¹Based on internal R&D hotspot and shade testing vs standard half cut TOPCon panels.

CELL DESIGN

Shingled-cell design



Bringing it all together

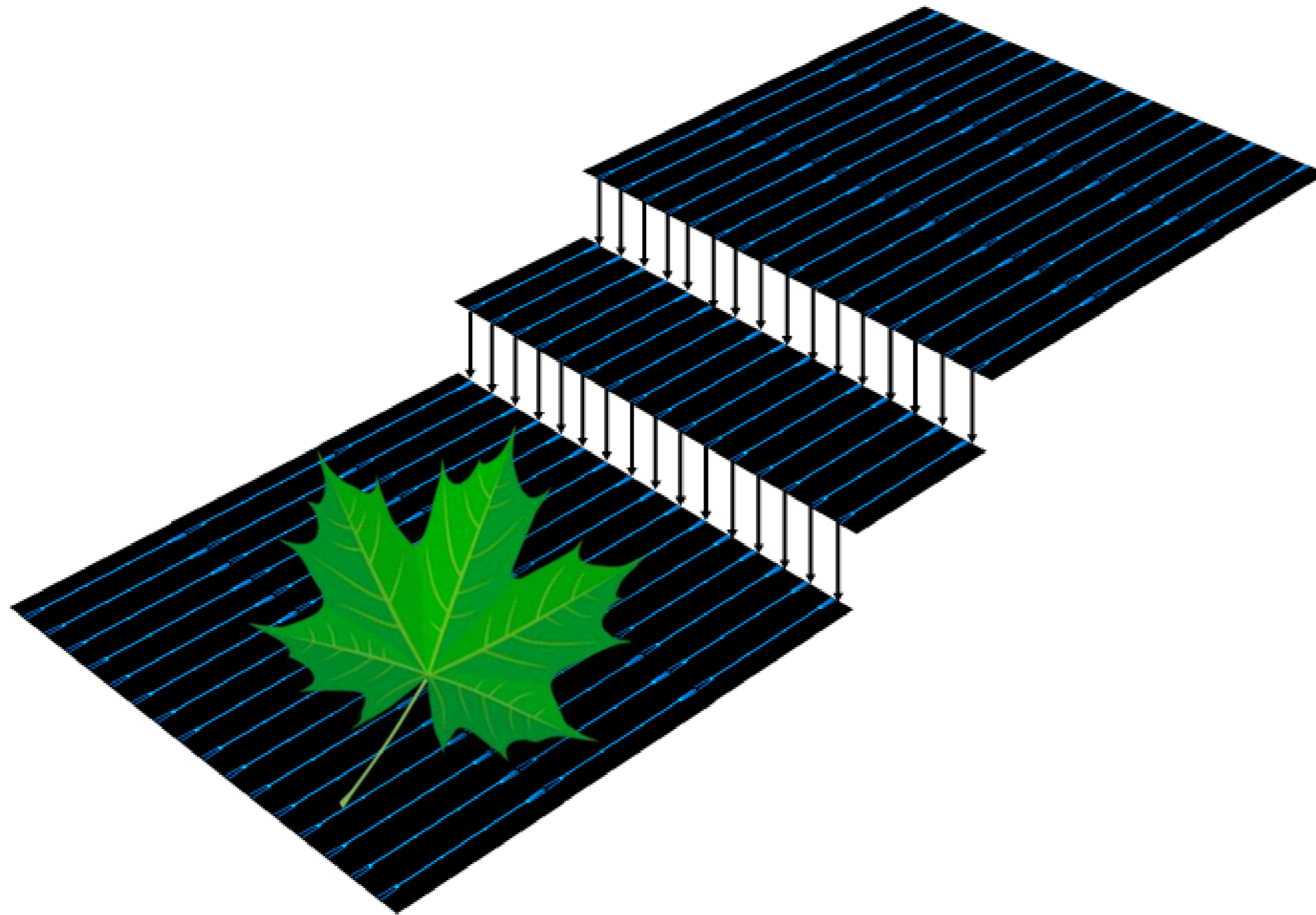
Performance's shingled-cell panel design weaves together individual solar cells to achieve harmonious results.

The overlapping shingles eliminate inactive "dead zones" between cells, capturing more light and boosting overall panel output. This translates directly to increased energy production.

Unlike standard half cut panels, where shading across a single cell can significantly impact output, shingled panels' more independent cells minimise power loss in shaded areas.

CELL DESIGN + CIRCUITRY

Shade management



Staying cool when shaded

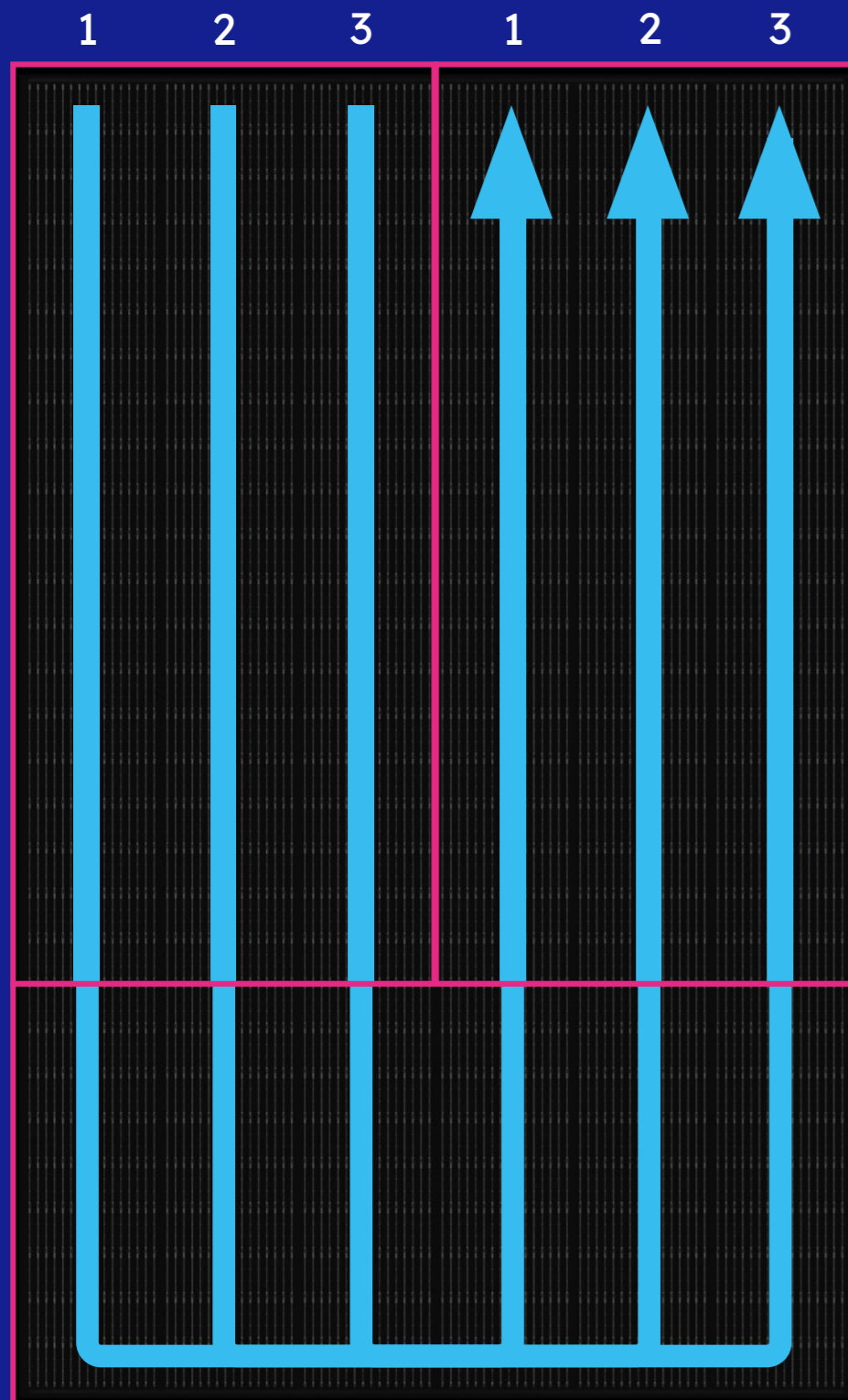
Integrating smaller cells **minimises shading impacts** and helps to isolate affected areas of the panel. As a result, shade has **less impact on overall panel efficiency**.

Bypass diodes create alternative paths for electric current, **reducing the risk of uncontrolled heating** and the formation of hotspots.

Reduced internal cell temperatures **prolongs the lifespan** of panels while **optimising energy generation** (even in suboptimal lighting conditions).

CELL DESIGN + CIRCUITRY

Power flow of Performance 7 panels



The Performance 7 panel's cells and circuitry are divided into **three sections**, each of which is managed by a **bypass diode**.

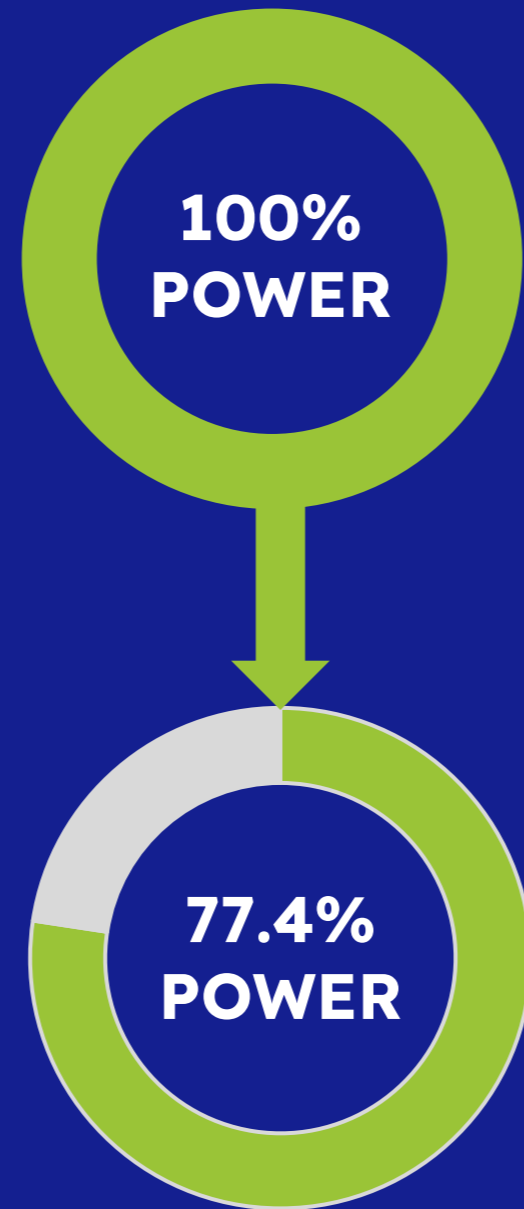
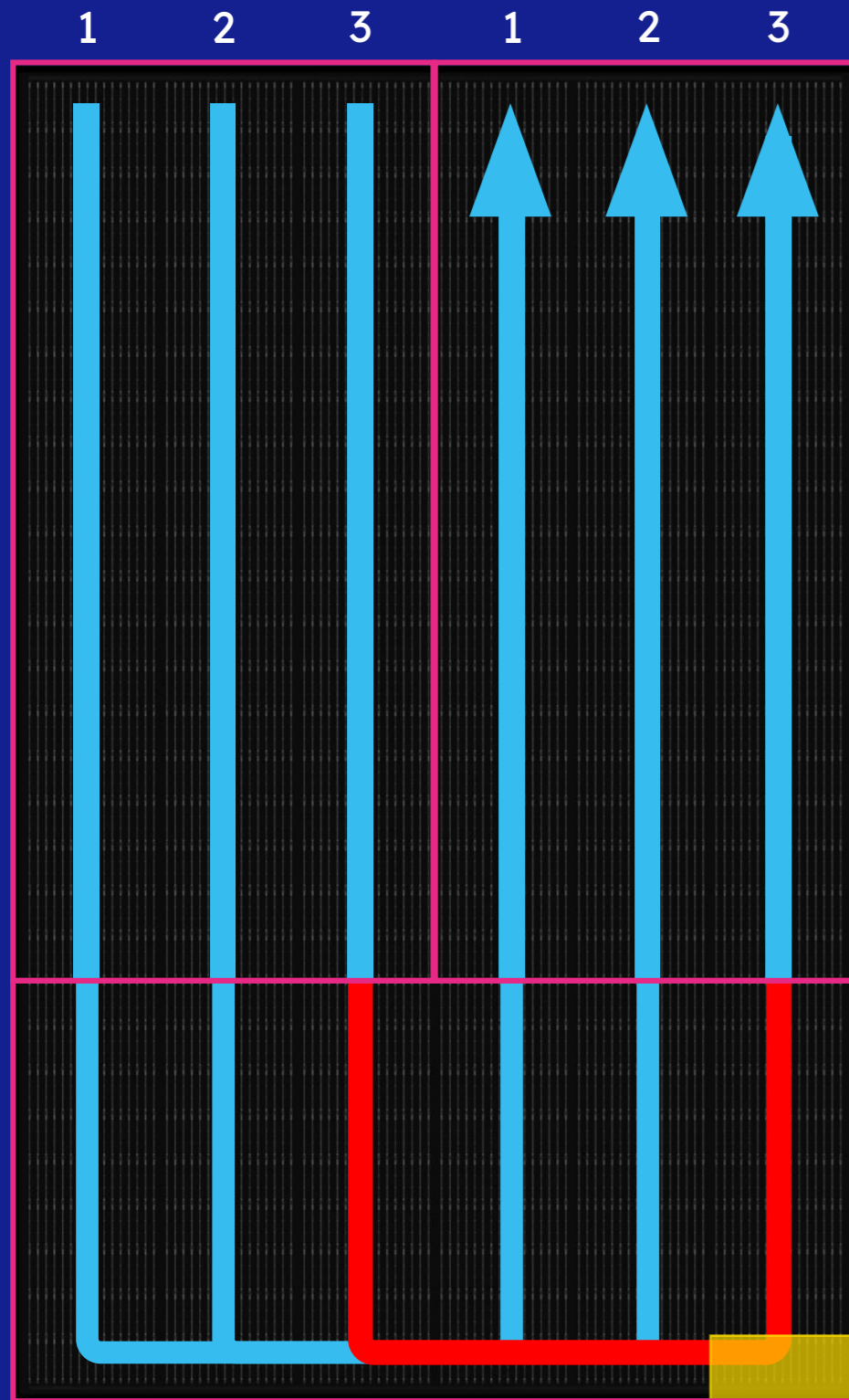
Cells are connected in three parallel substring circuits. Power flows through each substring in a 'U' shape, down one substring and then back up the corresponding parallel substring on the other side of the panel. On the image to the left, these substrings have been labelled either 1, 2 or 3.

In a perfect scenario, as can be seen in the image, power flows through the panel **uninterrupted**. However, if some cells become shaded, all other cells connected in the same parallel substring (within the same **bypass diode section**) will **experience power loss** as a result of the shading. Examples of this can be seen on slides following this one.

 Bypass diode section  Uninterrupted power flow

SHADE MANAGEMENT – SPOT

Power loss when subjected to shade



Performance 7 panels experienced a **22.6% power loss** from **spot shading**.¹

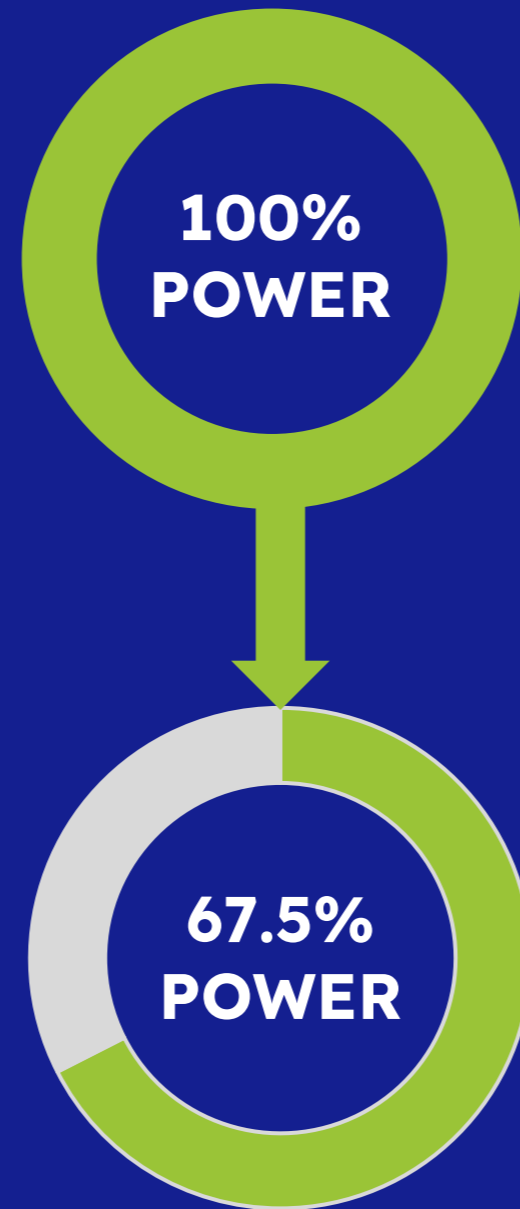
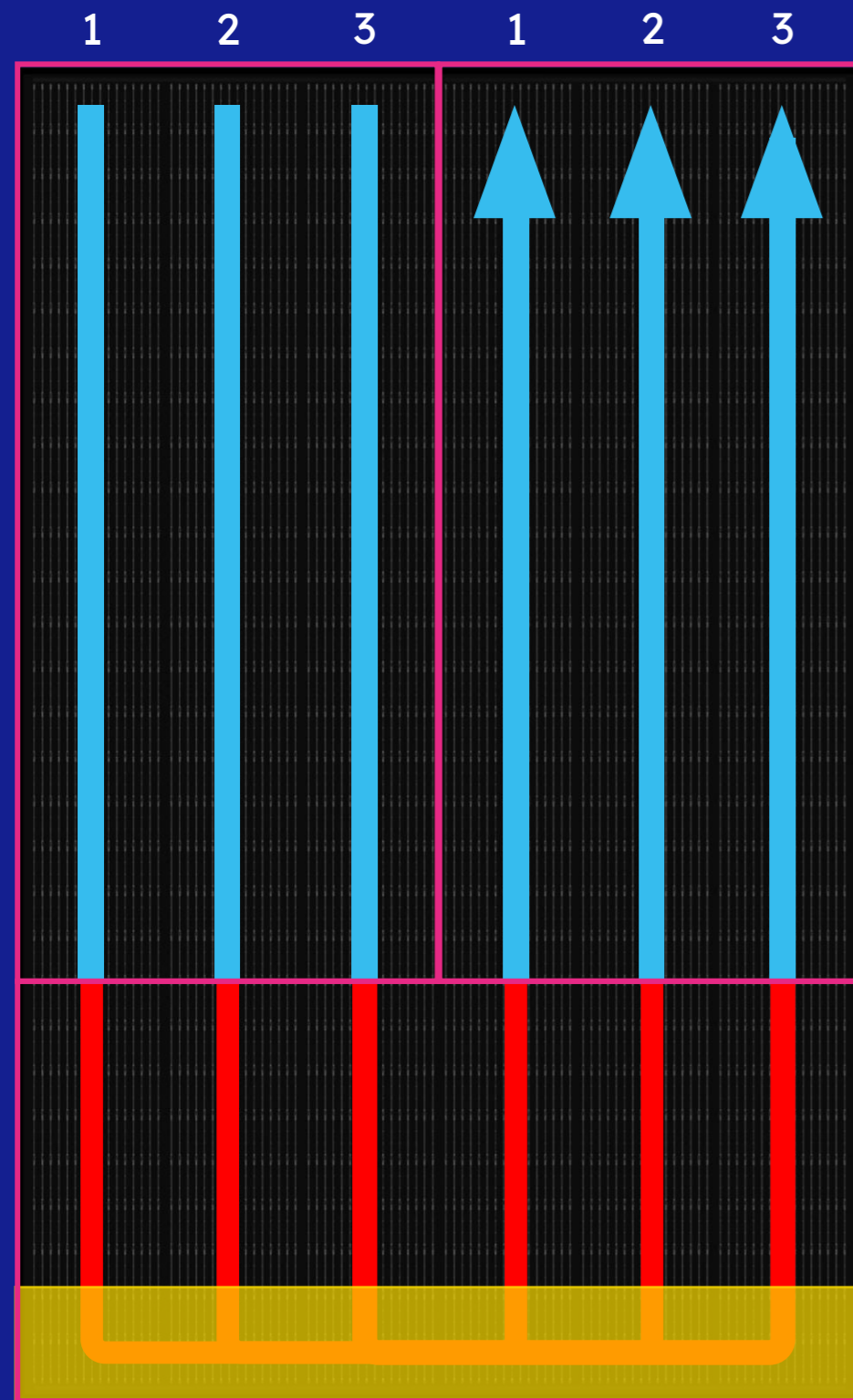
In comparison, standard TOPCon solar panels in the market showed a **35.0% power loss** under the same conditions.²

Performance 7 panels had **35.4% lower power loss** than the standard panels, showcasing their prowess regarding shade mitigation.

■ Bypass diode section **■ Uninterrupted power flow** **■ Experiencing power loss**

SHADE MANAGEMENT – SHORT EDGE

Power loss when subjected to shade



Performance 7 panels experienced a **32.5% power loss** from **short edge shading**.¹

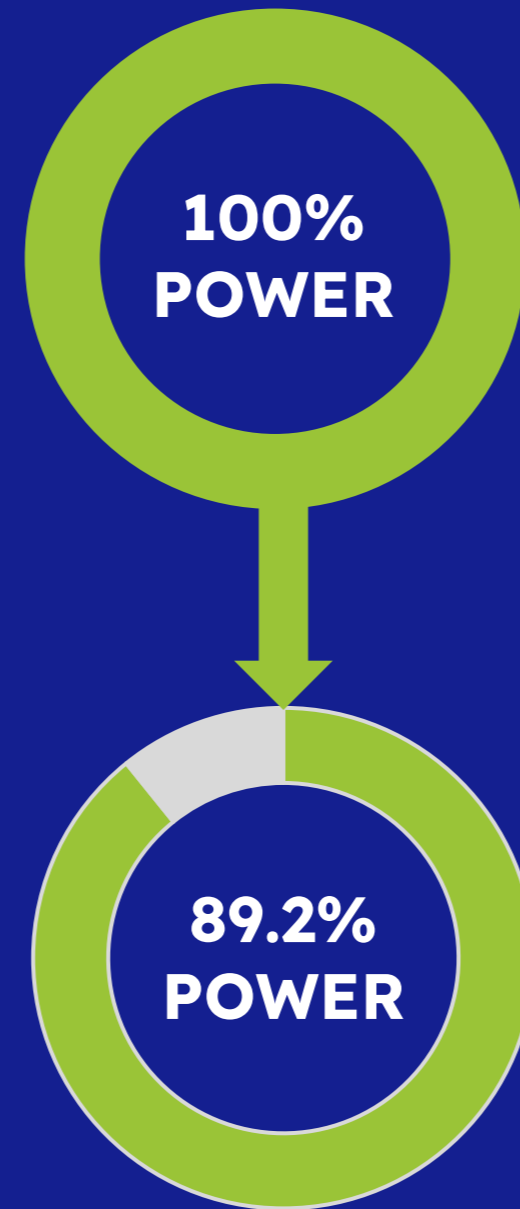
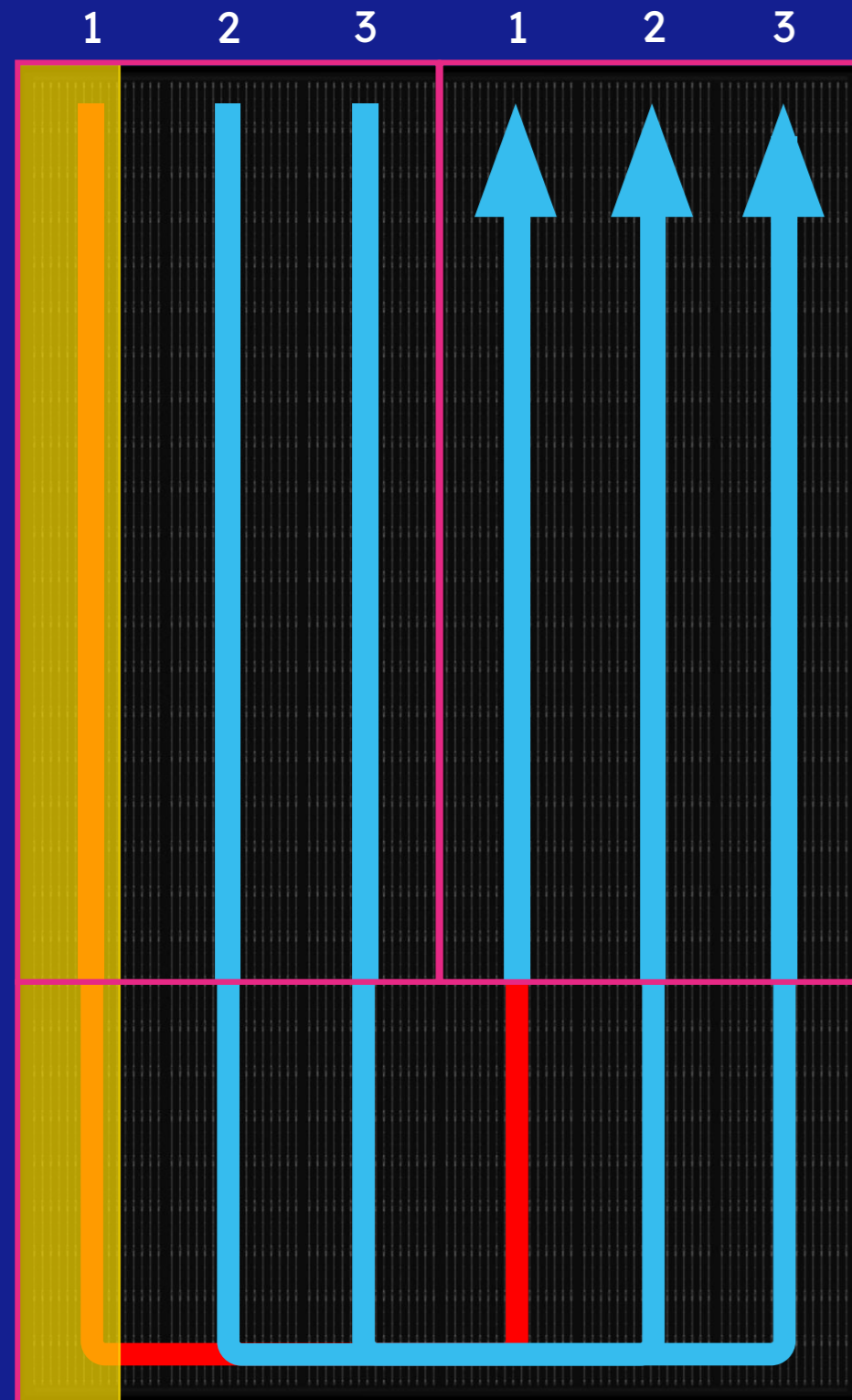
In comparison, standard TOPCon solar panels in the market showed a **40.0% power loss** under the same conditions.²

Performance 7 panels had **18.8% lower power loss** than the standard panels, showcasing their prowess regarding shade mitigation.

■ Bypass diode section **■** Uninterrupted power flow **■** Experiencing power loss

SHADE MANAGEMENT – LONG EDGE

Power loss when subjected to shade



Performance 7 panels experienced a **10.8% power loss** from long edge shading.¹

In comparison, standard TOPCon solar panels in the market showed a **35.0% power loss** under the same conditions.²

Performance 7 panels had **69.1% lower power loss** than the standard panels, showcasing their prowess regarding shade mitigation.

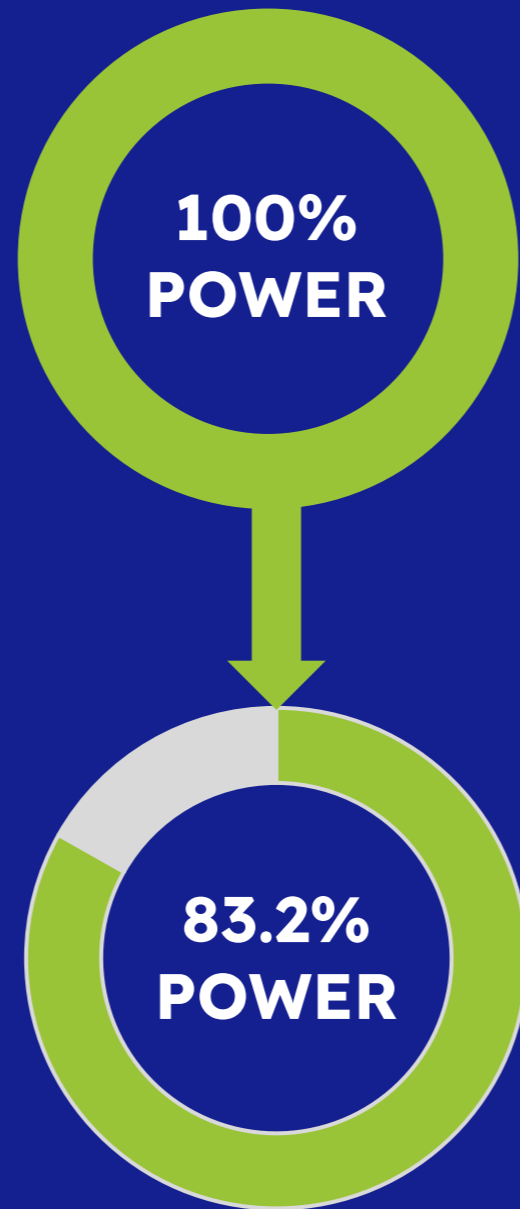
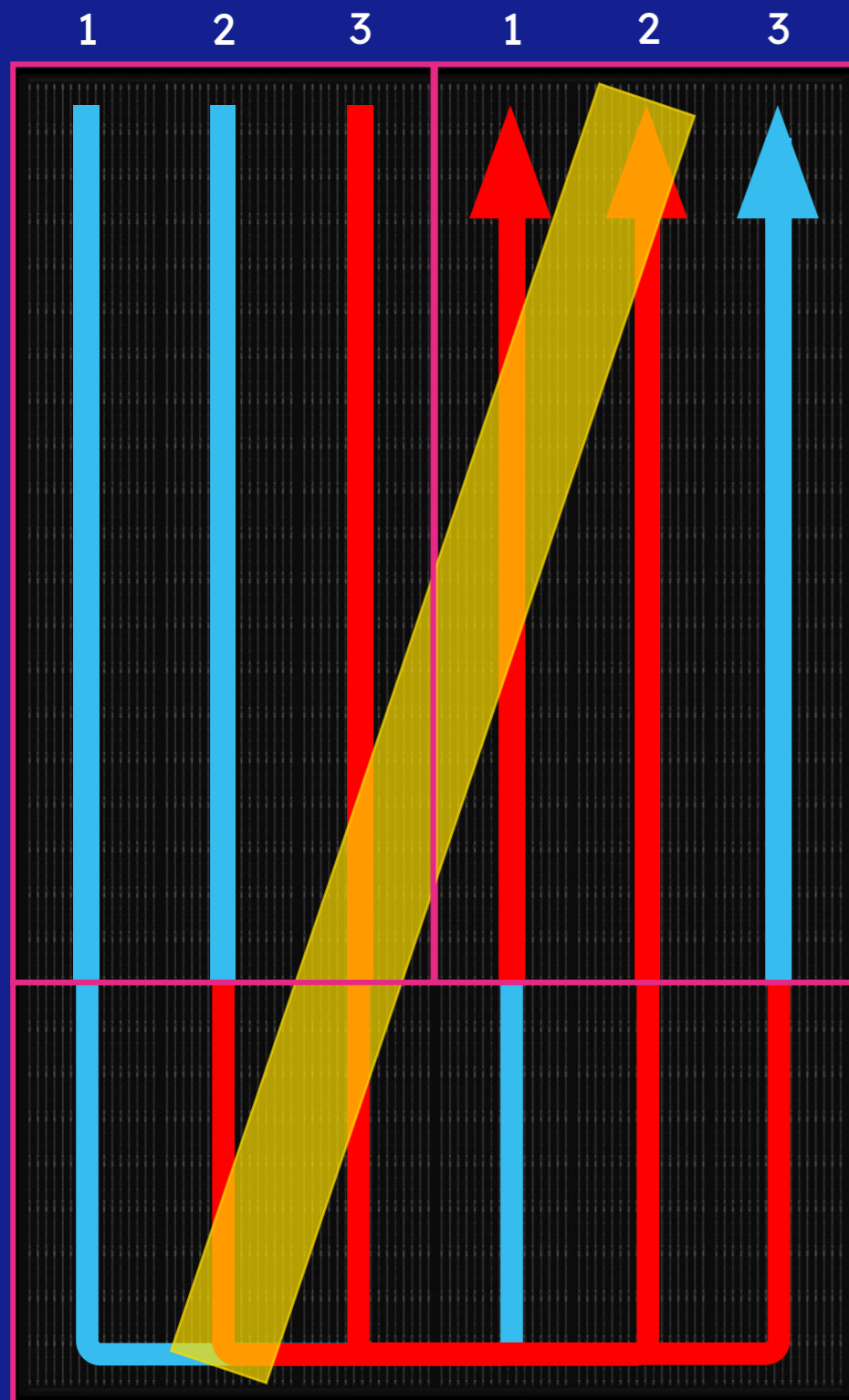
■ Bypass diode section **■** Uninterrupted power flow **■** Experiencing power loss

¹ 10% of the panel shaded on long side (single module, part of footnote two testing).

² Based on internal R&D hotspot and shade testing vs standard half cut TOPCon panels

SHADE MANAGEMENT – DIAGONAL POLE

Power loss when subjected to shade



Performance 7 panels experienced a **16.8% power loss** from **diagonal pole shading**.¹

In comparison, standard TOPCon solar panels in the market showed a **27.0% power loss** under the same conditions.²

Performance 7 panels had **37.8% lower power loss** than the standard panels, showcasing their prowess regarding shade mitigation.

■ Bypass diode section ■ Uninterrupted power flow ■ Experiencing power loss



A MORE RELIABLE CELL CONNECTION

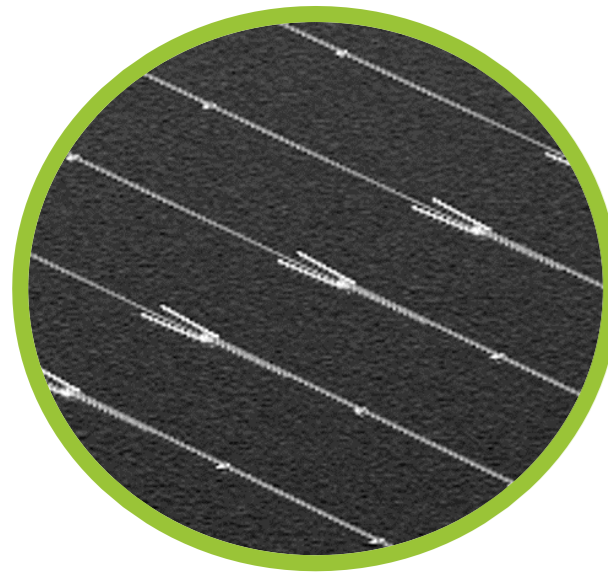
through flexible joint cell connections

Tested above the industry standard for Thermal Cycling (TC) to ensure reliability in the field.¹

¹ Based on results of internal Moxeon product testing for Performance 7 SKUs. Subjected to TC400 testing, an extra 200 cycles above IEC standard of TC200.

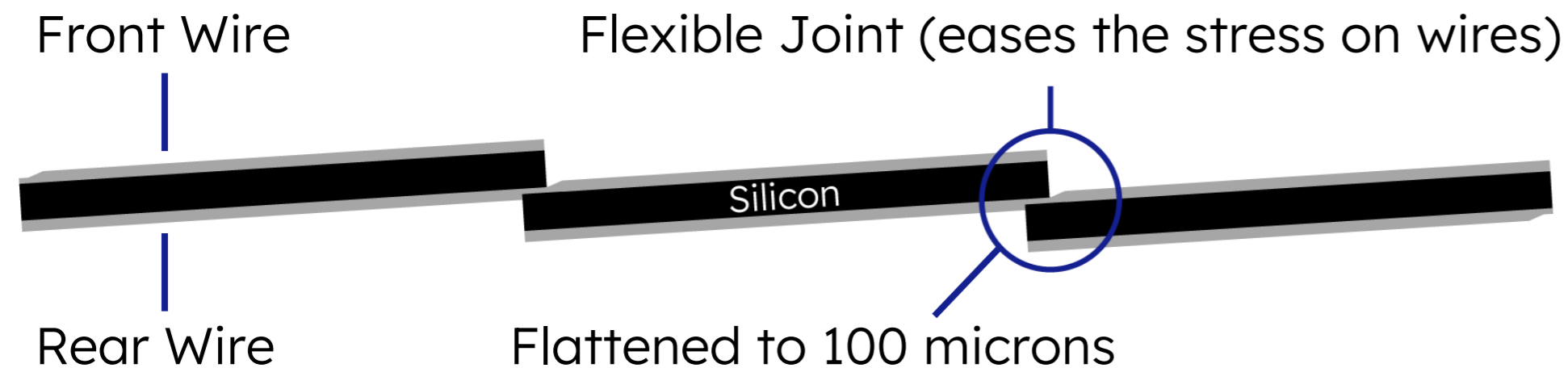
CELL INTERCONNECT

Flexible joint cell connections



Points of interconnection between cells.

Cross-section of Performance interconnect:



Connections that last

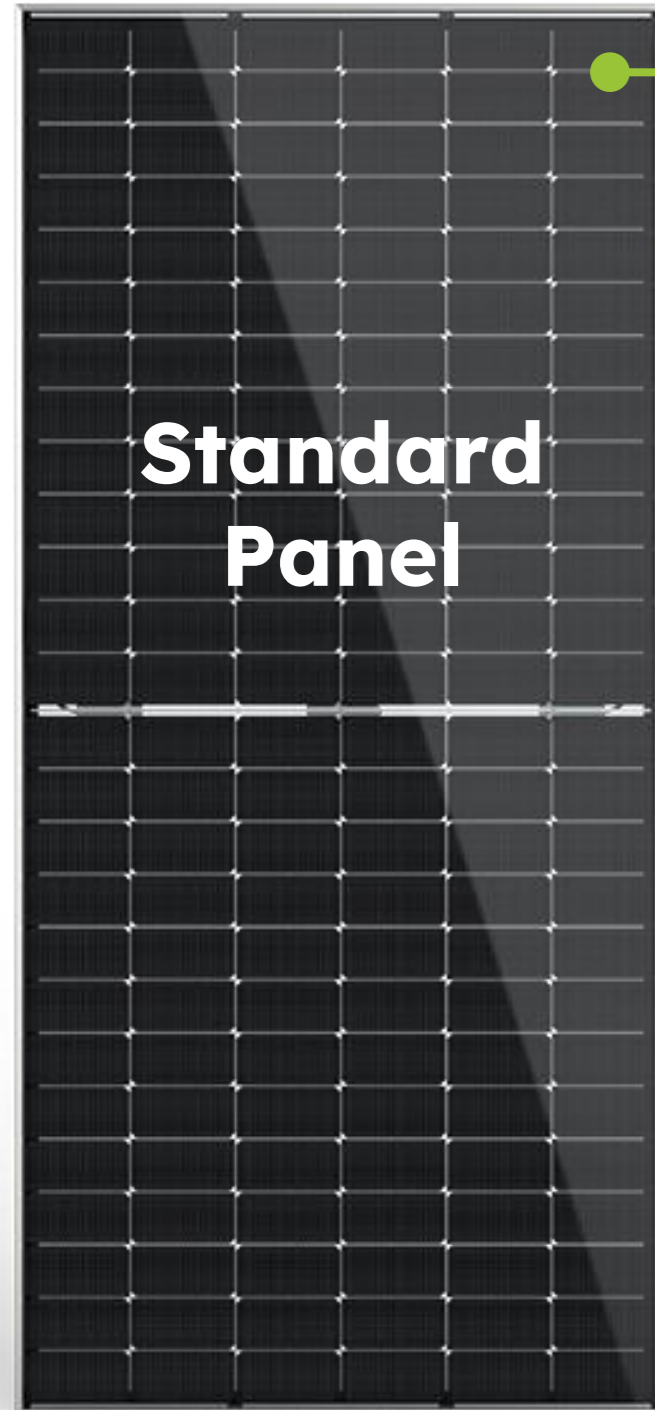
The metal wires that can be seen on Performance panels connect each overlapping shingled-cell. This forms a strong but flexible cell interconnect which helps **mitigate ribbon failure and cell cracking** generally caused by thermal cycling or excessive movement.

The wires run from the rear of one cell and connect to the front of the neighbouring overlapped cell.

The wires are flattened at the cell interconnect point to form a flexible joint. This provides **reliability advantages over standard panels.**

CELL INTERCONNECT

Comparative look at the technology



**Standard
Panel**



Silicon

Standard half cut panel 'S' curve interconnect

Susceptible to temperature swings

Prone to ribbon failure and cell cracks.

Rigid joint leading to more stress.

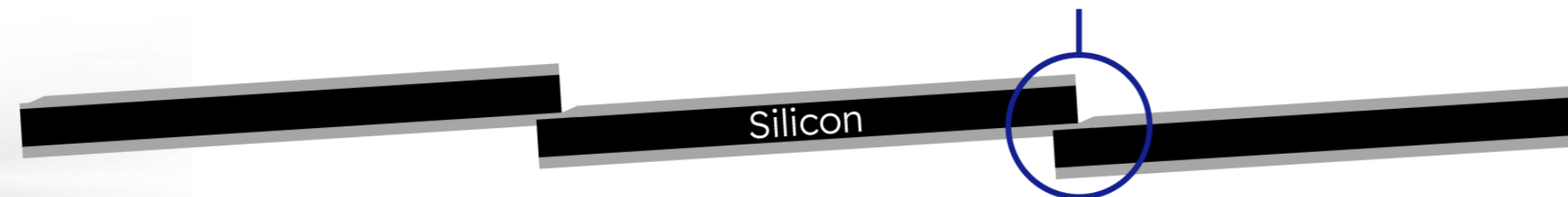
VERSUS

Resilient to temperature swings.

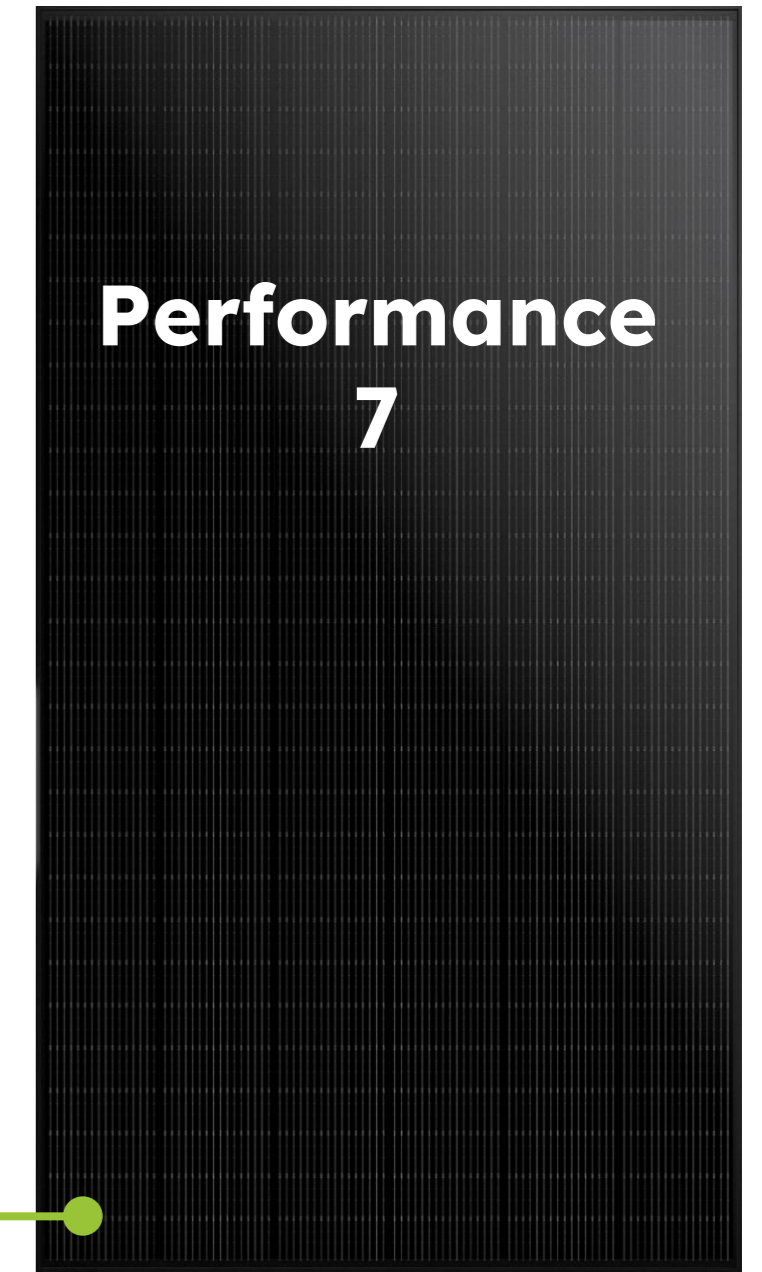
Resistant to ribbon failure and cell cracks.

Flexible joint resulting in less stress.

Performance flexible joint cell interconnect



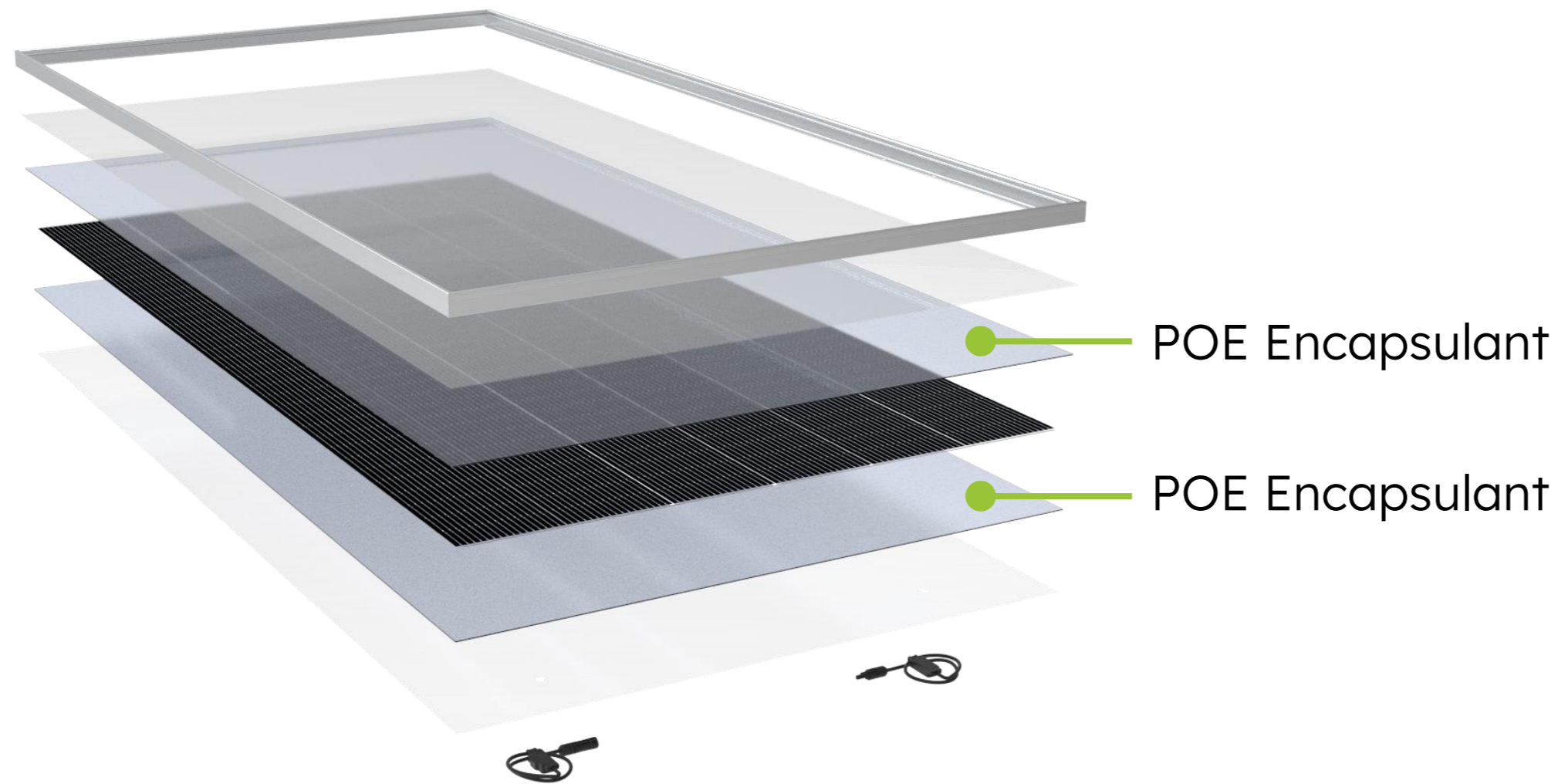
Silicon



**Performance
7**

MATERIALS

Premium Encapsulant



Premium panel protection

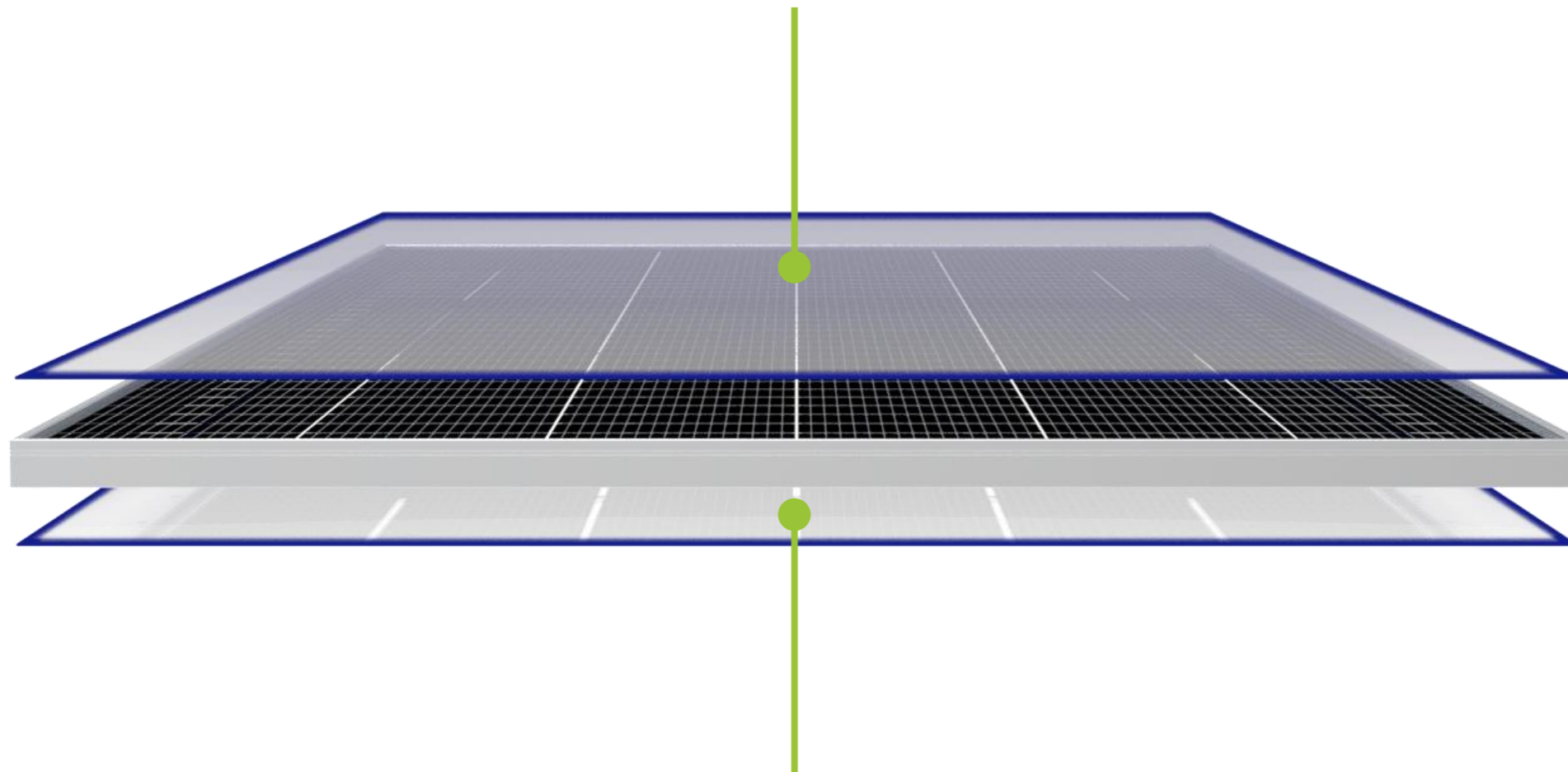
Performance retains the Polyolefin Elastomer (POE) encapsulant that has been utilised in previous generations.

POE encapsulant excels in protecting solar panels with its **superior durability** and **weatherproofing**. It boasts **exceptional moisture resistance**, keeping out harmful water and humidity-induced moisture, **boosting long-term production** (especially in harsh environments).

CONSTRUCTION

Glass/Glass (no backsheet)

2.0 mm, high-transmission heat strengthened anti-reflective glass



2.0 mm, high-transmission heat strengthened glass

Robust panel construction

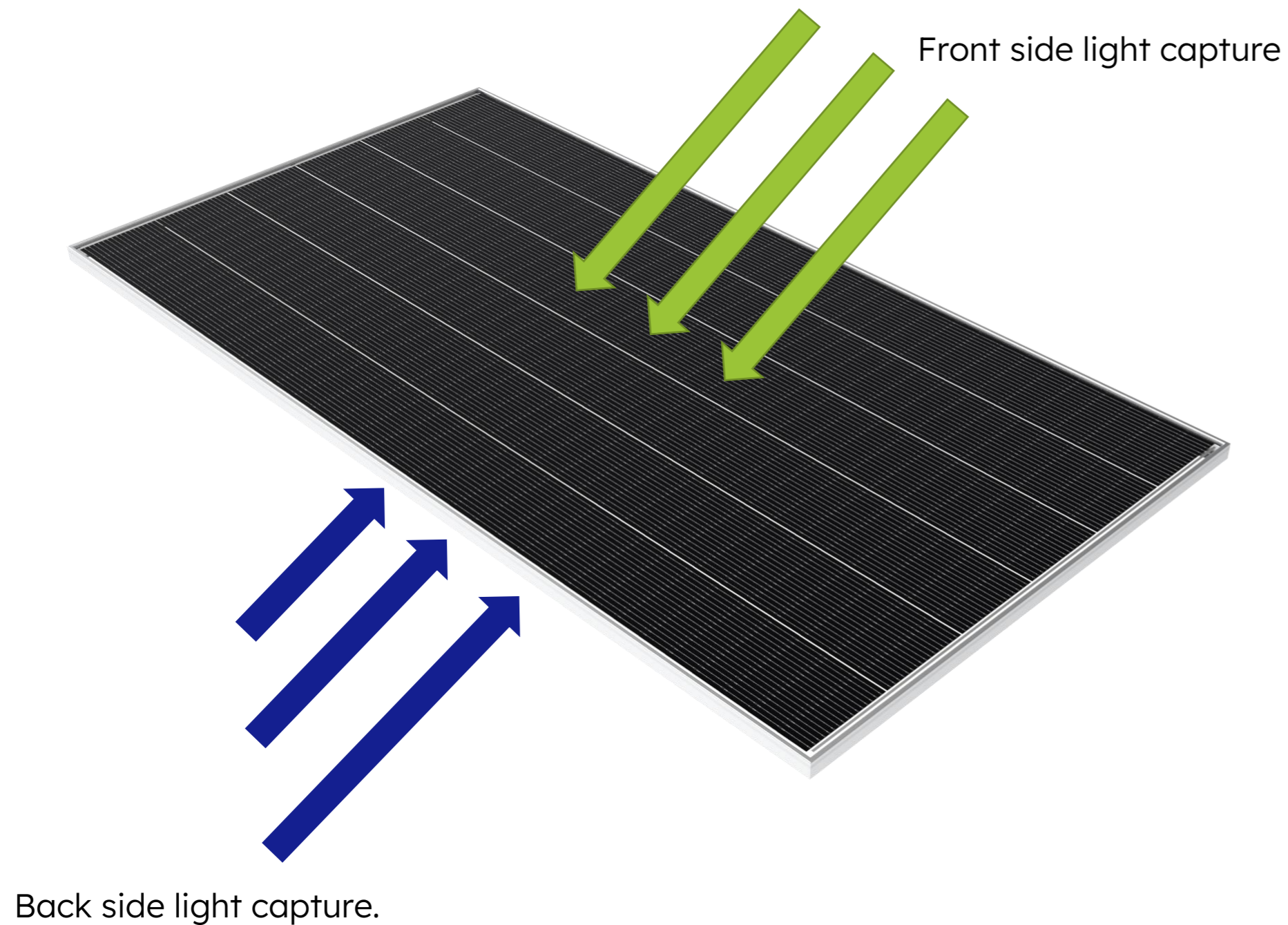
Performance 7 modules are a robust glass-glass construction.

Their double-layered glass construction enhances durability, safeguarding against environmental factors, installation stresses and ensures a longer lifespan.

The environmentally friendly design minimises waste and simplifies future recycling, contributing to a sustainable energy future.

BIFACIAL MODULES

Increased solar harvest



The best of both sides

Performance modules have seen increases in bifacial factor.

This is largely due to the strong bifacial capability of the TOPCon cells used, doubling the harvest surface area, **maximising light capture** from both sides and **potentially increasing overall system output** (depending on the installation and relevant bifacial installation considerations).

WARRANTY

A better product, a better warranty

Comprehensive Power, Product & Service coverage for 30 years

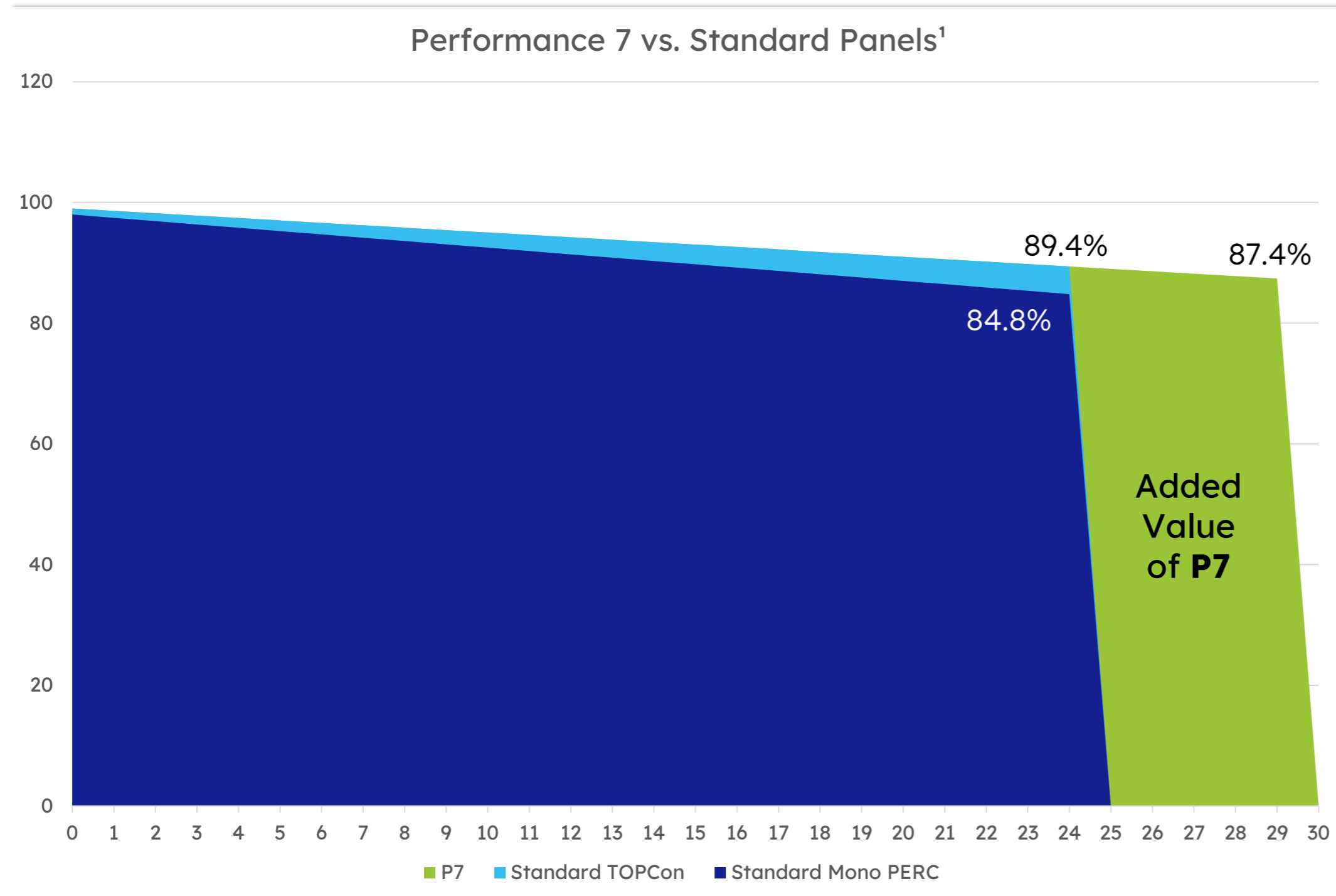
SunPower Performance 7 panels are manufactured for long-term durability—covering defects related to workmanship and materials for a full 30 years, versus some manufacturers that can go as low as 12 years on their warranty.

Performance 7 panels also account for the repair, replacement or refund of any defective panel for 30 years, with removal, shipping and installation included in applicable countries.



WARRANTY

Low panel degradation rates



SunPower Performance 7 panels have improved on year one warranted output, which is now **99.0%**.

Additionally, maximum annual degradation has decreased, and is now **0.40%** per year.

Lower panel degradation rates are a key benefit of N-type TOPCon solar panels. Allowing Performance panels to **produce more energy** over **a longer period** in comparison to standard panels.

Low panel degradation and long warranted product life help to drive **best market value** for the Performance product line.

¹ Comparisons are drawn over 'Warranted Product Life'. P7 = 30/30. CT1 TOPCon = 25/30. CT1 Mono Perc = 25/25. 'Annual Power Attenuation' taken from CT1 competitor datasheets.

Elegant design

Designed with aesthetics in mind, offering a sleek and modern appearance that enhances the visual appeal of all solar installations.

SUNPOWER

FROM MAXEON
SOLAR TECHNOLOGIES



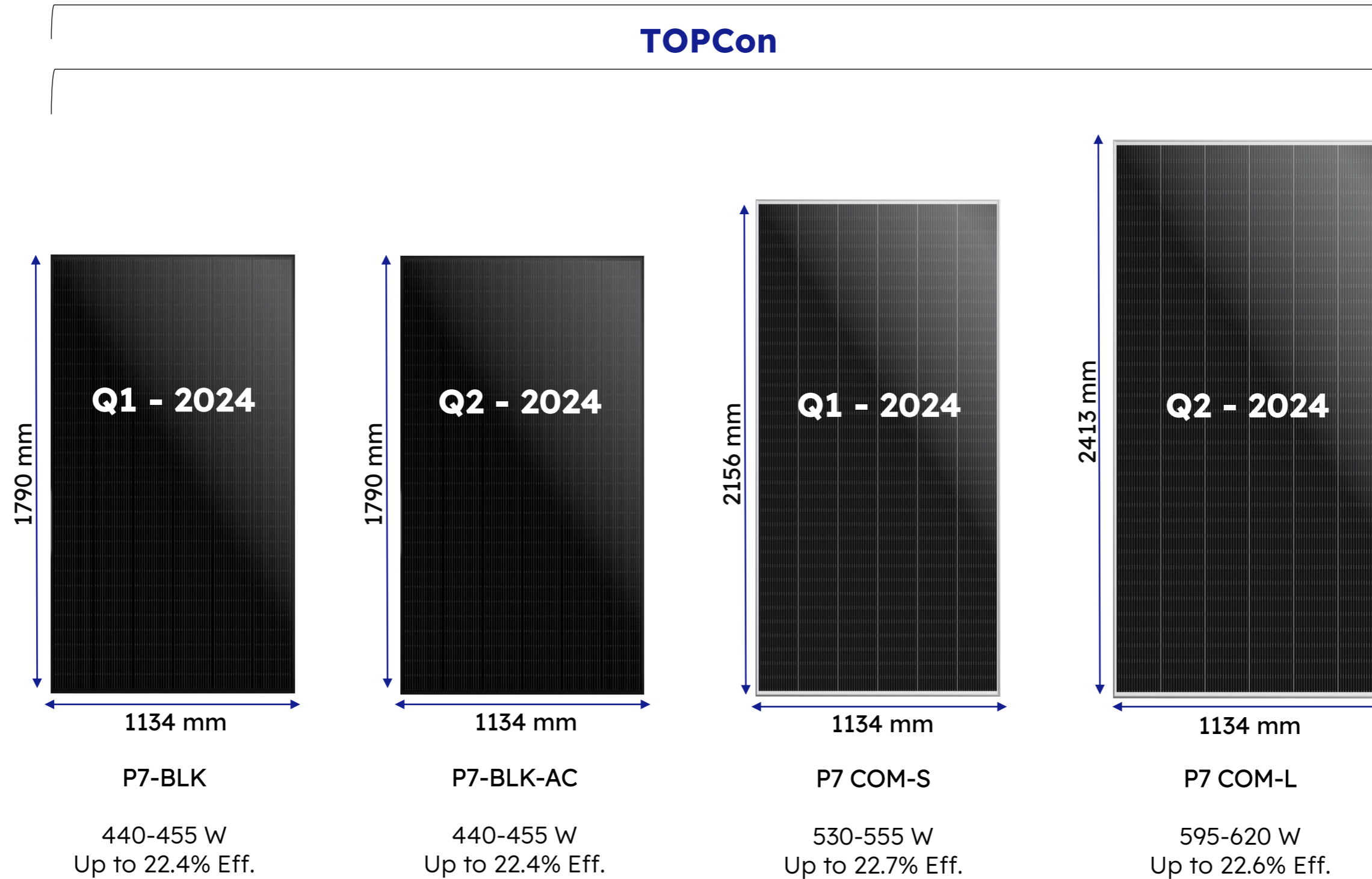
SunPower Performance 7 panel portfolio

PERFORMANCE PANEL PORTFOLIO

Roadmap for panel launches

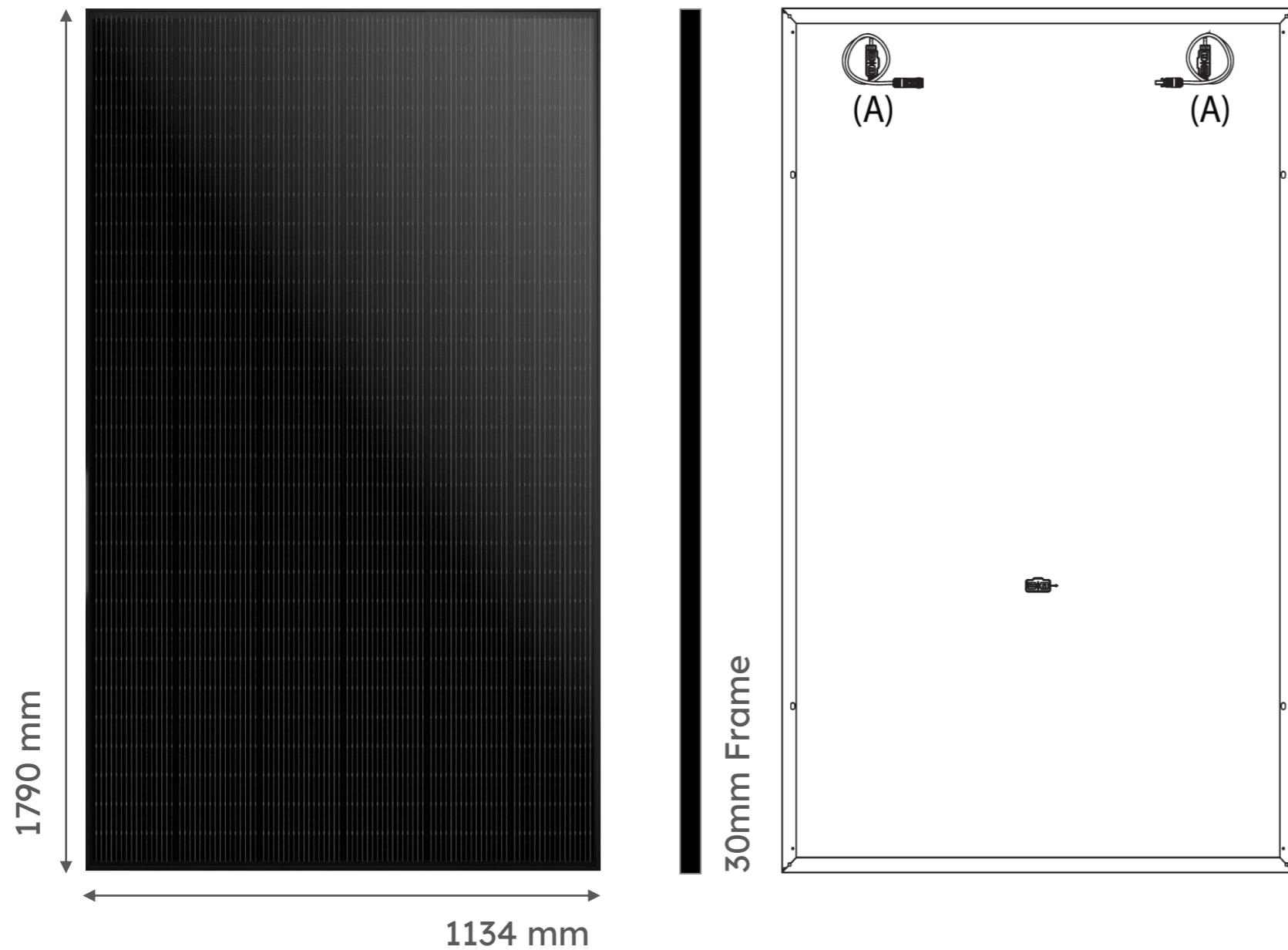
BIFACIAL

TOPCon



PERFORMANCE PANEL PORTFOLIO

SunPower Performance 7 BLK



SPR-P7-xxx-BLK

Up to 455W | Up to 22.4% Efficient



Ideal for residential applications



Bifacial Generation

FEATURES

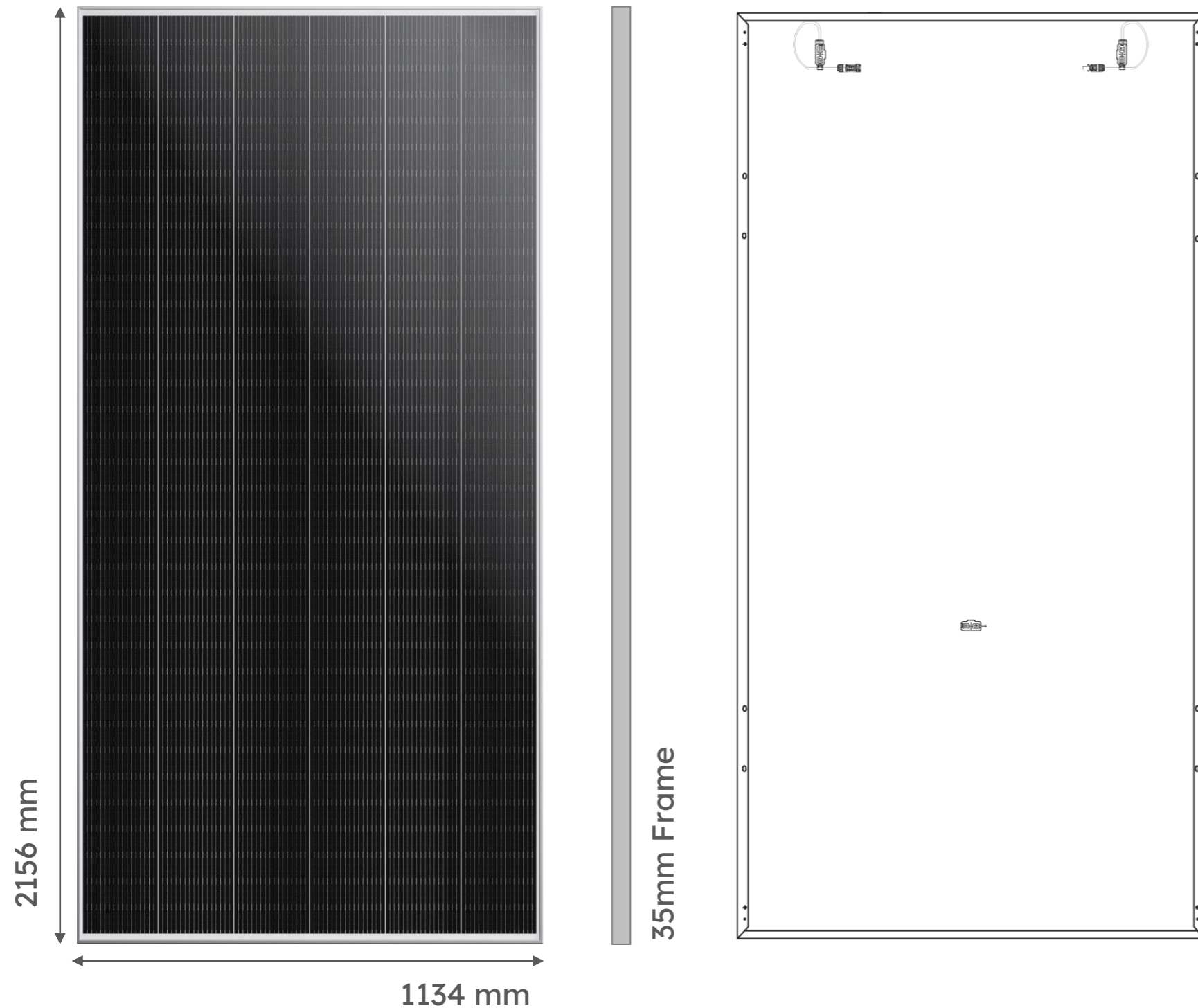
- Bifacial power generation
- Glass-Glass construction, black frame
- Full square 182mm (G10) solar cells
- 30 mm frame
- 3 Junction boxes, 3 Diodes (1 each)
- Cables: (-) 1200 mm / (+) 1200 mm
- MC4 Connectors

WARRANTY

Power, Product, Service	30/30/30
Year 1 min warranted output	99.0%
Maximum annual degradation	0.40%

PERFORMANCE PANEL PORTFOLIO

SunPower Performance 7 COM-S

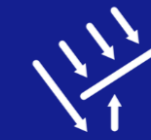


SPR-P7-xxx-COM-S

Up to 555W | Up to 22.7% Efficient



Ideal for
Commercial
Applications



Bifacial
Generation

FEATURES

- Bifacial power generation
- Framed glass-glass construction
- Full square 182mm (G10) solar cells
- 35 mm frame
- 3 Junction boxes, 3 Diodes (1 each)
- Cables: (-) 1500 mm / (+) 1500 mm
- Connectors: EVO2

WARRANTY

Power, Product, Service	30/30/30
Year 1 min warranted output	99.0%
Maximum annual degradation	0.40%

Summary

Engineering a better panel

- ✓ Performance panels are engineered to address the most common causes of solar panel degradation.

Key Advantages of Performance 7 Panel

- ✓ Clever Cell Design – Shingled, One-third Cut Cell
- ✓ Shade Management
- ✓ Flexible Joint Cell Interconnect
- ✓ High Quality Materials and Construction
- ✓ Comprehensive Warranty

SUNPOWER

FROM MAXEON
SOLAR TECHNOLOGIES

